DOCUMENT RESUME

ED 164 568 TM 007 766

AUTHOR Ackerman, Amy S.
TITLE Adjunct Questions: Help or Hinder? A Critical Review of Theoretical and Empirical Research with Specific Regard for Age and Ability of the Learner, and Level of the Question.
PUB DATE 77
NOTE 151p.; Best copy available

EDRS PRICE MF-$0.83 HC-$8.69 Plus Postage.
DESCRIPTORS *Ability; *Advance Organizers; *Age; *Complexity Level; Educational Research; Evaluation Criteria; Incidental Learning; Intentional Learning; *Learning; Learning Processes; Learning Theories; *Literature Reviews; Prose; Psychological Studies; Questioning Techniques; Recall (Psychological)

ABSTRACT

Adjunct questions are test-like items interspersed at regular intervals, preceding or following prose passages, with the intention of increasing subsequent learning. In this state-of-the-art review, studies which include three major variables--age, ability, and question complexity level--are examined to determine whether a particular combination of the variables increases an individual's control over learning (either incidental or intentional learning). The following conclusions are supported: (1) the use of adjunct questions may facilitate intentional learning (especially with low ability students), but fails to increase incidental learning; (2) deeper processing and greater learning and retention result when higher order questions are employed; (3) when adjunct questions are used with young learners, the recall of processing strategies should be stimulated prior to reading the instructional passages; and (4) additional research with special attention given to different learning outcomes, types of memory structures, transfer tasks, aptitude-treatment interactions, and the influence of other modes of instruction (nonprint media) should be conducted. The appendix contains an outline of criteria for the evaluation of published research; a critical review of twenty-five articles related to adjunct questions; and a proposed experimental study. (CP)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED164568

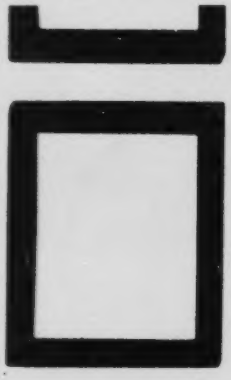
BEST COPY AVAILABLE

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Adjunct Questions: Help or Hinder??????

A Critical Review of Theoretical and Empirical Research with Specific Regard for Age and Ability of the Learner, and Level of the Question



TM007 766

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Amy Ackerman

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

A. S. Ackerman

IDD 655

Summer, 1977

Adjunct Questions: Help or Hinder ????

A Critical Review of Theoretical and Empirical Research with Specific Regard for Age and Ability of the Learner, and Level of the Question.

Amy S. Ackerman

The Florida State University

IDD 655

Summer, 1977

Table of Contents

Abstract 1-2

Introduction 3-4

Organizational Framework 5

Historical Compendium 6-10

Problem Statement 11-18

- Age 13
- Ability 14
- Level of Question 15
- Interaction of Variables 16

Objectives 19-20

Definitions of Terms 21-22

Scope and Selection Criteria 23-26

Procedure for this Review 27-30

General Theoretical Framework 31-42

Specific Theoretical Framework Relating to Variables.. 43-53

Critical Analysis of Twenty Experimental Studies..... 54-80

- Age 59-66
- Ability 66-69
- Level of Question 69-75
- Interaction of Variables 75-78
- Analysis Conclusions 78-80

Reflections on Objectives 81-95

- Information Processing Model/Adjunct Questions: How They Relate 84-85
- Exercising Control over One's Learning 86
- Analysis of Empirical Evidence 87
- Weaknesses and Limitations of the Studies 87-89

Recommendations for Future Research 89-94

Additional Recommendations and Summary 95-99

References 100-109

Appendix A-- Criteria for the Evaluation of Published Research 110-119

Appendix B-- Adjunct Questions: A Timely Focus on Intellectual Skills 120-139

Abstract

The purpose of this analysis of the literature is to critically examine theoretical and empirical research in the area of adjunct questions, which are test-like items interspersed at regular intervals, preceding or following prose passages, with the intention of increasing the amount of subsequent learning. Three major variables (age and ability of the learner, and level of questions) serve as the focal point around which the review revolves. Mathemagenic behaviors, which basically propose that both intentional (question related) and incidental (question unrelated) learning are facilitated by the use of adjunct questions, are addressed. An extensive general theoretical framework which encompasses the hypothesized constructs under an overall umbrella provided by an information processing model of learning theory is presented, and a specific theoretical framework for each of the selected variables is included.

A basic question of this study is, "Does the use of adjunct questions facilitate the development of strategies which enable an individual to exercise control over his/her learning, and consequently, increase the amount of intentional and incidental learning when reading prose passages?" Sufficient, conclusive support to verify the development of strategies necessary for the exercise of control over an individual's own learning was not found in the experiments studied. However, intentional learning appears to increase with the use of adjunct questions, while incidental learning does not. The critical analysis of the twenty selected experiments produces the conclusions listed below:

1. The use of adjunct questions may facilitate intentional learning (especially with low ability students), but fails to increase incidental learning.
2. Deeper processing and greater learning and retention result when higher order questions are employed.
3. When adjunct questions are used with young learners, the recall of processing strategies should be stimulated prior to reading the instructional passages.
4. Additional research with special attention given to different learning outcomes, types of memory structures, transfer tasks, aptitude-treatment interactions, and the influence of other modes of instruction (nonprint media) should be conducted.

The purpose of this critical review of literature is to investigate empirical results and theoretical, pragmatic, and future implications of studies involving adjunct questions, which are test-like events interspersed at regular intervals, preceding or following instructional passages, and are designed to enable an individual to exercise control over his learning in order to achieve predetermined objectives. Carroll (1971) postulates that regulating one's own thinking is an essential skill, and through the use of adjunct questions, one may reorganize memory traces and associations in addition to performing memory searches.

Researchers use numerous phrases for the term, "adjunct question"; however, within this paper, the following are considered to be synonymous: self-tests, self-checks, embedded tests, self-evaluative responses, interspersed test items, auto-elucidative instruction, and practice tests.

As a result of responding to these self-check items which are interspersed within the materials, in many cases the learners not only master the explicit objectives emphasized in the adjunct questions (intentional learning), but also, learn other information not covered in the self-test items (incidental learning). This phenomenon,

often referred to as "mathemagenic behavior" (Rothkopf, 1966), has been the focal point of numerous reviews of research (Barry, 1974; Carver; 1972, Faw & Waller, 1976; Frase, 1970; Ladas, 1973; Rickards, 1977), which stress the lack of a theoretical framework and the presence of inconsistent results within the experimental studies conducted in this area.

Kerlinger (1964, p. 14) states that "part of the essential core of scientific research is the constant effort to replicate and check findings, to correct theory on the basis of empirical evidence, and to find better explanations of natural phenomenon." Therefore, a major purpose of this paper is to acquaint the reader with some of the theories and results reported within studies concerning the use of adjunct questions in which researchers attempt to test deduced implications of their hypotheses. Further, it is hoped that by analyzing and integrating selected studies, some more definitive conclusions can be made regarding the use of adjunct questions within learning materials.

Before presenting an extensive theoretical framework for this review, it seems desirable to address two specific concerns: the first, is an overall framework for the organization of this paper, and the second, is a brief historical synopsis of the research which sets the stage for this review. Thus, the reader may obtain a grasp of the area, prior to launching into the specific aspects of research included within the major portion of the paper.

Overall Framework of this Review

Historical Compendium

Problem Statement

Objectives

Definitions of Terms

Scope and Selection Criteria

Procedure for this Review

General Theoretical Framework

Specific Theoretical Framework Relating to Each Variable

Critical Analysis of Twenty Experimental Studies

Reflections on Objectives

Additional Recommendations and Summary

References

Appendices

Historical Compendium

The investigation of test-like events interspersed within written material is not new. The literature contains reports from studies such as Gates (1917) and Jones (1923) who observed the beneficial results of answering questions following completion of written passages.

In 1926, Pressey used a "testing machine" which enabled a learner to receive feedback as to the progress he/she had made, correct errors, and receive guidance as to which areas were deficient. It should be noted that Pressey advocated the reading of an entire chapter of text prior to responding to the self-test items, which differs from most procedures today.

Later, Washburne (1929) originally reported prequestions (placement of questions prior to reading a particular passage) to be significantly better than postquestions or the absence of questions. As Carver (1972) illustrates in his review, later reanalysis of Washburne's data, this time using a more appropriate statistical technique, resulted in a nonsignificant difference, and furthermore, no group scored higher than the control group. Not only is the Washburne study of interest due to its early date, but also, this is one of the few studies in which younger learners (eigth and ninth graders) were included as participants.

For capsulization of the past studies, some theory must

now enter the discussion in order to proceed with the historical synopsis.

As still advocated today, attention (processes whereby learners translate nominal stimuli into effective stimuli) is an important factor in learning from written material (Anderson, 1970). At least two processes are involved in attention: the first process is orientation of the receptors toward the stimulus, and the second process is the encoding of the stimulus, where response is actually the effective stimulus.

With this attention phenomenon in mind, Hoffman (1946) conducted a study involving undergraduates who read a history book for four consecutive hours. Electrodes were attached near the readers' eyes using electroculograms to determine a pattern of eye movements associated with reading steadily for this four hour period. A deterioration was revealed in which the frequency of eye blinks and variability of eye movements increased, while the number of lines read per minute decreased.

Following Hoffman's study, Carmichael and Dearborn (1947) monitored eye movements of high school and college students as they read continuously for six hour periods. Unlike the Hoffman study, Carmichael and Dearborn gave a quiz covering the preceding material after every twenty-five pages. It was concluded that as a result of the tests, fatigue was reduced, as indicated by the eye behavior records.

Briggs (1949), a student of Pressey's, conducted studies in which special devices (punchboards) were used that enabled students to take self-instructional tests. The results of the experiments led Briggs to conclude that immediate knowledge of results attributed to the superior performance of students who participated in accelerated college seminars and experienced self-instructional tests of factual and applicational nature, by means of punchboard devices. Thus, thirty years ago, Briggs was not only an early advocate of adjunct questions, but also, he varied the level of question to which the students responded (factual and application). Extremely interested in this type of learning, Briggs later reviewed research involving "adjunct auto-instruction" and generated a comprehensive technical report (1967) in which he analyzed and synthesized his findings, inclusive of the period prior to 1967.

Pressey (1950) reported experiments involving college psychology students in which he used three levels of adjunct questions per chapter: content, judgments, and applications to practical situations. Mechanical devices were designed and utilized in order to only require a student to repeat items he/she had previously answered incorrectly. Thus, after the first round of questions, the items that the student mastered were deleted from the set.

Later, Pressey (1964) criticized programing, and advocated the use of "adjunct-auto elucidative" questions with feedback. It is interesting to note that Pressey

included page references in self-tests, so students could pursue any incorrect answers, and headings, which provided structure within the test.

Greatly influenced by historical research in this area, particularly that of Hoffman, Carmichael, and Dearborn, another researcher, Rothkopf (1966), divided a 5,200 word chapter from Rachael Carson's book, The Sea around Us (1961), into seven sections, each three pages in length. Before or after reading each section of the chapter, groups of paid volunteers answered two questions based on that section. After the entire chapter was completed, a criterion test was administered, which included questions practiced while reading and additional questions that were not practiced. Rothkopf's attentional hypothesis, asking questions before a person reads a passage should cause him/her to search for answers to these questions, and would not be expected to facilitate performance on nonpracticed questions contained in the achievement test, was confirmed.

Further, Rothkopf (1966) conducted experiments using postquestions, which followed the reading passages and found that facilitative effects resulted in two types of learning: intentional and incidental. The former results from exposure to the questions and answers only, and the latter results from untreated material, that is, material not covered in the questions.

Misunderstandings often take place concerning Rothkopf's work in the area of adjunct questions. Rothkopf (1970),

himself, states that his experiments are mainly concerned with incidental learning, not directly related to the text components on which the experimental questions are based. Thus, any measured behavior change is not due to direct instructional effects of the questions, but to changes in presumed inspection behavior, which he calls mathemagenic activities. As is discussed later, the use of adjunct questions does not always produce positive results.

It is stressed that adjunct questions are not the only type of activities which are investigated regarding mathemagenic behaviors; that is, other learning activities such as advance organizers (Ausubel, 1963), instructions to learners (Postman, Burns & Hasher, 1970), cueing and retrieval strategies (Salatas & Flavell, 1976), and instructional objectives (Rothkopf & Kaplan, 1972) are addressed.

Thus, throughout the past fifty years, activities have been studied which require responses from the learner in hopes that acquisition and retention of verbal information is enhanced. It is these activities which modify inspection behavior of the learner that are termed mathemagenic behaviors by Rothkopf, and are hypothesized to result from the use of adjunct questions interpsersed among reading texts.

Now that the reader is abreast of prototype studies which investigated the use of adjunct questions within prose materials, and has received a glimpse of the origins from which the limited theory has evolved, it is time to state the problem with which this paper is concerned.

Problem Statement

A previous search of the literature related to the use of adjunct questions, made by this writer, reports ten variables and results among the fourteen studies which were reviewed. (See Appendix A) As stated in the section of this paper which deals with the general theoretical framework, there are studies reported in the literature which are contradictory with regard to the results based upon the absence or presence of adjunct questions, as well as the positioning of the questions (that is, pre or post) in prose material used in the experiments. These contradictory reports may, in part, be influenced by the lack of a well developed and logical conceptual framework necessary for the design of experimental studies.

Early literature in the area of adjunct questions seems to emphasize how retention of verbal information (facts) can be enhanced in order to increase the amount of learning, rather than how these questions affect the mental processes of the learners. More precisely, insufficient attention is devoted to the influence of adjunct questions on the development of strategies within an individual that enable him/her to encode, store, and retrieve information contained within prose material. Researchers in experimental studies, which most frequently involve undergraduate psychology students, insert pre or post questions into reading passages and compare retention results with control groups (who often

consume less time than the experimental groups). In some cases where "significant differences" are reported, credit for the differences is given to the location of the adjunct questions (either pre or post). On the other hand, some researchers who find nonsignificant differences recommend additional research is necessary.

One study, reported by Swenson and Kulhavy (1974), explains the nonsignificant results by concluding that fifth and sixth graders process information differently, and some students are too young to evoke search strategies through the use of adjunct questions. Unfortunately, their report does not recommend types of additional research that might be conducted to explore the strategies of young children.

However, other researchers, such as Brown (1973) and Salatas and Flavell (1976) report studies in which it is demonstrated that young learners can be taught to use cue retrieval strategies. A question that arises is, "Can a strategy for attending to facts of a specific category be taught for text learning through the use of adjunct questions inserted into the materials?" Further, "Under what conditions (age, ability, and such) are these questions most facilitating?" And finally, "How do these conditions influence types of processing, outcomes, and strategies for control of learning?"

A substantial number of variables relating to the use of adjunct questions may be found in the various journals; thus, a list of all of them would be too lengthy to include

here. Examples would be the amount of study time, absence or presence of feedback concerning correctness or responses, administrative directions, type of learning material, and many others, some of which are listed in a composite of studies previously examined by this writer (See Appendix A, Table A page 122).

The search of the literature by this author reveals a lack of studies which deal with three important variables: age of the learner, ability of the learner, and level of the questions used. The importance of the effect of the variables used in combination (interaction) should be stressed.

Age

In one of the few studies in which young learners participated, the investigators (Swenson & Kulhavy, 1974) found that the use of adjunct questions depressed incidental learning in the children. On the other hand, Brown (1973), and Salatas and Flavell (1976), report that children can be taught to use strategies for search and retrieval. Yost (1970) reports a significant difference in the amount of incidental learning when adjunct questions are used with seventh graders. In this study, the level of adjunct questions used is highly complex.

The crucial question posed here is, "At what age may

learners benefit from adjunct questions in order to develop skills which enable them to exercise control over their learning?"

Ability

As in the case of the few studies dealing with the use of adjunct questions with young children, so it is with the studies relating to the use of adjunct questions with children of different ability levels. The findings are often inconclusive and conflicting. For example, the following reveal results of experimental research which support the use of adjunct questions for low ability students: Allen (1970), Furman (1974), and Shavelson, Berliner, Ravitch, and Loeding (1974). In contrast, Halstead (1973) and Sanders (1973) recommend these test-like events for high ability students.

Inconsistent terminology regarding what is meant by "ability," and variations in instruments used to measure ability cause confusion when attempting to draw conclusions or generalize the results of present research involving these self-tests embedded within prose passages. Further, the specific ranges which encompass "high ability" or "low ability" are rarely indicated within the report.

Theoretical hypotheses such as those which embrace Salomon's aptitude-treatment interaction models (1972), attempt to provide conceptual framework as to why one ability group results in a facilitating effect when using

interspersed questions, whereas, another group experiences debilitating effects when using the questions. For example, Salomon hypothesizes that low ability students benefit from this type of activity since these "compensatory effects" provide opportunity for rehearsal of material contents within the learner, whereas high ability students do not require additional rehearsal, and thus find the questions debilitating due to their interference within the learner's internal processing system (1972).

Again, as in the above regarding the age of the learners, the question posed here is, "How does the ability level of the participants in experiments with adjunct questions affect the development of strategies necessary to enable individuals to regulate control of their learning?"

Level of Question

Anderson and Biddle (1975) postulate that the level of question (lower order which requires recall of facts, whereas higher order requires application) acts as a stimulus which influences the type of internal processing that occurs within the learner. They theorize that recalling only facts demands superficial processing, while higher level questions require deeper level semantic processing.

Findings reported by some researchers (Felker & Dapra, 1975; Halstead, 1975; Rickards & DiVesta, 1974; Watts & Anderson, 1971) support the hypothesis that higher order

questions contribute to better overall performance on all question types.

On the other hand, Furman (1974) found lower level questions facilitated learning more so than higher level questions. It should be noted that Furman did not provide the participants with any feedback concerning the correctness of their responses. In addition, the difficulty level of the passage used by Furman was inappropriate for the students, thus resulting in only 50% of the sample mastering the instructional treatment.

At the risk of being redundant and perhaps overly critical, the inconsistency of the results of the studies is once again emphasized.

The question raised here is, "How does the level of adjunct questions influence the mental processing within the learners, their inspection behaviors when reading prose, and their ability to develop control of their learning?" And further, "Do different levels of questions affect the type and amount of learning (both intentional and incidental) that take place?"

Interaction of Variables (Age, Ability, Question Level)

Although each of the previously mentioned variables is of great importance, the effect each has in combination (interaction) with one another and the total impact of the three in concert are critical in the study of adjunct questions.

The ultimate question might be stated, "At what age, with what level of ability, and using what level of adjunct question is learning facilitated?" A restatement might be, "Is there a particular combination of the three variables (age, ability, and level of question) which causes the use of test-like questions to enable learners to develop strategies within themselves so that they may control their learning?"

Although some theoretical and empirical research reports regarding these variables (age, ability, and level of question) are present within the literature, integrations of these studies have not addressed the relationship among the variables, either theoretically, empirically, or pragmatically. A purpose of this paper is to pursue this point.

Within this paper studies which include the three variables are examined in order to summarize and synthesize findings in a manner not yet attempted. The difficulty of such a task is increased because of the fragmented and often contradictory theoretical constructs proposed by the researchers, in addition to the conflicting results of empirical data collected by the researchers. It is hoped that some conclusions or generalizations may be formed which recommend specific age and ability groups that might benefit from particular levels of questions in order to develop strategies within learners that enable them to regulate control over their learning.

Although findings of studies involving adjunct questions which demonstrate an increase in the amount of intentional and incidental learning may lead a researcher to infer that the development of these strategies has taken place, this inference does not directly address a more crucial concern, the mental processes that occur within the learner.

Thus, the review of studies selected for this paper investigates not only the concern of whether or not adjunct questions serve as necessary stimuli which facilitate the amount of intentional and incidental learning of prose material, but also, the internal learning processes (described by the information-processing model) which take place during the development of strategies (executive control processes) which enable an individual to exercise control over his learning.

Objectives

The objectives of this critical analysis are to:

1. Provide a general theoretical framework encompassing the various adjunct question constructs hypothesized by researchers, and generate a specific theoretical framework for the variables addressed in this paper (age and ability of learners and level of question).

2. Develop the relationship of each variable with the information-processing model of learning theory.

3. Locate data which either support or do not support the use of adjunct questions as a means by which children and adults can, in fact, be taught to exercise control over their learning.

4. Critically examine and integrate empirical evidence concerning the effects adjunct questions have on learning from prose material in regard to the age and ability of learners and question level.

5. Indicate weaknesses and limitations in the studies which may attribute to the numerous inconsistencies in findings.

6. Examine, compare, contrast, and tabulate operational definitions of the variables and instruments used.

7. Determine whether or not data support the use of adjunct questions to increase the amount of learning (intentional

and incidental), and in what types of circumstances.

8. Provide practical suggestions as to how the adjunct questions should be used, and under what conditions.

9. Recommend areas of future research which might be investigated concerning the use of adjunct questions, and the development of strategies which enable individuals to exercise control over their learning.

Definitions of Terms

adjunct questions - test-like items interspersed preceding or following regular intervals of prose materials designed to facilitate intentional and incidental learning.
synonyms for adjunct questions: self-tests, embedded tests, self-evaluative responses, interspersed test items, auto-elucidative instruction, practice tests.

intentional learning - question related

incidental learning - learning unrelated to interspersed questions.

mathemagenic behavior - learners modify inspection behavior and master not only explicit objectives as in those emphasized with adjunct questions, but also, other information not addressed in self-test items (incidental learning).

age - chronological age (by grade level)

ability - the skill of performing mental or intellectual tasks.

lower order questions - recognition or recall of facts.
(Verbal information in accordance with Gagné; knowledge and comprehension in the eyes of Bloom)

higher order questions - require transformations (processing) of information by application of concepts, rules, problem solving (Gagné); application / analysis (Bloom).

information-processing model of learning - stimulation encountered by the learner is transformed or processed in a number of ways by internal structures during the period in which the changes identified as learning take place.

prequestions - questions placed before reading segments.

postquestions- questions placed after reading segments.

executive control - (cognitive strategies) internal processes which serve to select, modify, and regulate processing implemented by individuals during learning.

verbal information - factual recall (Gagné)

intellectual skills - enable the learner to interact with his/her environment using symbols as exemplified in reading or writing (concepts, rules, problem solving/ Gagné)

inspection time - time permitted for study of materials.

Scope and Selection Criteria

Theoretical and empirical research concerning the use of adjunct questions in prose materials constitute the main thrust of the present report. Experimental studies which provide hard research data, and reviews and theoretical articles from which insights may be drawn have been critically analyzed.

The criteria which were employed for the selection of the studies examined are described below.

Variables

Three major variables, age and ability of the learners, and the level of questions, were selected for thorough examination. Therefore, each of the studies analyzed included at least two groups of different ability, at least two levels of questions, and/or participants below the twelfth grade.

Recency

The experimental studies which were examined were conducted between 1964 to 1977. For a review of research regarding adjunct autoinstruction prior to 1964, references may be found in the work of Briggs (1967).

Sample

The following criteria related to sampling procedures were used to select the experimental studies which were analyzed in this report:

1. The learners must have been able to read prose materials.

2. The age or grade levels of the learners must have been indentified in the studies. A special effort was exerted in order to obtain studies employing younger learners as participants.

3. The selection procedure concerning participants must have been indicated; that is, if the participants were volunteers, the studies must have so reported, and stated how they were compensated. If the participants were not volunteers, the studies must have described how they were selected.

4. The study must have included descriptions of the composition of the experimental and control groups, which must have been comparable.

5. The sample must have contained at least forty participants.

6. Group assignment must have been made on a random basis. If stratification procedures were employed, details of the methods were desirable.

Availability

With the exception of doctoral dissertations, no unpublished studies were considered. Each study cited is available in the form of a journal article, a published book or document, or on microfilm or microfiche. The studies must have been conducted in the United States.

Depth and Detail

Only those studies which reported sufficient details to permit desired analysis were examined. Therefore, abstracts of larger

documents were not considered as acceptable sources of data.

Treatment Materials

Criteria related to the instructional materials which comprised treatments during the experiments were as follows:

1. The treatments must have been self-instructional; that is, they must be printed prose materials which did not require intervention by the experimenter. However, assistance was available in the event that problems did arise.

2. The topics and lengths of passages used in the treatments must have been reported.

3. Passages used by the experimental groups must have contained questions interspersed before or after designated portions, to be answered by written student response.

4. Each passage must have been at least 800 words in length; however, longer treatments were preferred.

5. The location, spacing, and level of questions used must have been indicated.

6. The type of feedback, if provided, must have been described.

7. The experiments must have been conducted in a classroom environment.

8. Reports of validation procedures, such as pilot studies, reliability coefficients, and techniques of the treatment materials should have been included.

Instruments

The assessment instruments employed in the studies were desired to include procedures, reliability and validity coefficients; however, these data were seldom included.

Procedures in the Experimental Studies

Studies selected for analyzation were those which reported procedures that were implemented prior to, during, and following the experiment. Studies which contained glaring unethical procedures were not considered.

Additional desirable criteria for these experimental research reports are found in Appendix B.

Statistical Techniques and Analysis

The reports selected were those which described the statistical techniques used, and which reported the finding of significant or nonsignificant differences (no greater than .05) between or among the groups. Effect sizes were desired, but seldom included in the reports.

Procedure for the Preparation of this Review

The stimulus for this review is a research proposal (see Appendix A), that was written by this author. Attention is further directed to Appendix B, which lists criteria one should seek in the conduct and report of experimental research.

The 1977 edition of Annual Review of Psychology (see Wittrock for reference) served as a source of specific areas in which theoretical questions concerning adjunct questions are raised, which yet remain unanswered. Examination of educational psychology articles and texts facilitated this writer in determining the direction which might be pursued in the attempt to generate a theoretical umbrella that would encompass the various constructs concerning these test-like questions inserted in prose.

Concurrent with this focus on building a theoretical framework, manual literature searches were conducted using the following indices:

Annual Review of Psychology (1977)
Education Index
Psychological Abstracts
Review of Research in Education (1973)
ERIC Publications (Current Index to Journals in Education; Research in Education)

The following descriptors were employed in the searches:

questioning techniques
incidental learning
intentional learning
attention

cognitive processes
learning processes
research stimuli
student motivation
verbal learning
task performance
memory

The initial stages of development for theoretical frame-work required examination of various learning theories. It was concluded that a contemporary information-processing model would best account for the hypothesized constructs generated by the various researchers.

At this point, numerous articles were skimmed in order to limit the present investigation to three major variables which are the focal point of this review: age and ability of the learners, and level of questions. Rationales and further details regarding the selection of these variables are described within the problem statement.

Next, the initial sections of the paper were prepared, which include historical compendium, problem statement (variables), objectives, scope, general theoretical frame-work, and specific frame-work for each variable.

The literature searches produced a multitude of studies regarding the use of adjunct questions, to which the outlined selection criteria (see Scope) were applied with particular emphasis on the three main variables stated in the above section.

The objectives were employed not only as target areas, but provided organizational framework for the paper.

After careful screening of the articles and classification by variables, twenty studies were selected for critical analysis.

In order to conduct the analysis in a systematic manner, a matrix was generated for efficient, tabular recording of design procedures and results from the studies (see Table 1), which permitted the clustering and integrating of findings, rather than merely providing a series of lists from the studies.

A critical analysis of the studies was performed in order to attain the original objectives stated in an earlier part of the paper. The selected variables were used as organizational structure for the analysis and integration of the studies.

In addition to mini-summaries and conclusions within each section, an overall information-processing summary provides an integration of the theoretical and empirical studies concerning adjunct questions.

As an evaluative summary, the original objectives were reexamined as a means of achieving internal cohesiveness (see Reflections on Objectives). Each objective was evaluated in regard to the focus it received in the paper, and to determine whether it was, in fact, achieved.

An extensive section consisting of pragmatic implications and future research recommendations concludes the major text of the paper.

As a post script, careful attention was addressed toward

the recording of the seventy-five references included in the paper.

The next two portions of this paper address theoretical framework, which should be examined prior to investigation of empirical results from experimental research.

General Theories Relating to Adjunct Questions

This section examines the purpose of instructional sequences which ultimately promote learning and constructs which have been generated by researchers to account for hypothesized mathemagenic behaviors which take place as a result of responding to adjunct questions. The bulk of this portion of the paper delineates an information-processing model for learning, which this writer feels constitutes the umbrella under which the remaining theoretical fragmentations may be covered.

Further, the unanswered perplexity of where questions occur (prior to, or following written passages), is treated in conjunction with various theories and empirical data which attempt to provide some recommendations for designers of instruction in accordance with the type of learning desired (intentional and/or incidental). Specific theoretical framework for the variables (age, ability, and level of question) identified for analysis in this paper are discussed in a subsequent section.

The Purpose of an Instructional Sequence

Gagné (1973) purports that an instructional sequence is designed to generate the stimulus situation for learning. He explains that a total set of relevant stimuli should be included in an event in order for an instructional sequence

to be effective. Stimuli that activate a performance set (or expectancy) enable the learner to adopt a set to perform in the manner required by the learning task. This performance set (or expectancy) may be brought about in a number of ways, such as verbal statements or questions directing attention to the task.

Frase (1970) refers to the previous activities as "orienting directions," which are considered to have positive mathemagenic effects by Rothkopf (1970), due to generation of processes that facilitate learning. Frase defines these orienting directions as stimuli which dispose the reader to respond to certain aspects of a text, such as advance organizers (Ausubel, 1963), or adjunct questions.

These orienting directions may be interpreted as follows (Gagné, 1973): the orienting directions (questions or such), activate a temporary disposition, usually called a "set" which he later refers to as "expectancy" (Gagne,1977). The set (expectancy) initiates a selective search strategy (referred to by Rothkopf as inspection behavior), that determines what stimuli will be attended to by the learner, and how these stimuli will be encoded for storage in memory. Of next concern might be placement of these stimuli.

The Pre/Post Question Controversy

Several major reviews of adjunct questions (Anderson & Biddle, 1975; Faw & Waller, 1976; Frase, 1970; Rothkopf, 1972)

conclude that groups given questions inserted after related text segments (postquestions), retain more information than groups given questions before related text segments (prequestions) or groups given no questions (control). The hypothesized advantage of postquestions over prequestions is related to the claim that they produce a greater recall of incidental material (nonquestioned), while simultaneously producing equivalent recall of intentional material (directly questioned during reading of the passage).

However, an impressive number of studies (Felker & Dapra, 1975; Rickards, 1976; Rickards, Anderson, & McCormick, 1976; Rothkopf & Bisbicos, 1967; Sanders, 1973; Shavelson, Berliner, Ravitch & Loeding, 1974), have reported that prequestions equal postquestions in recall of both intentional and incidental learning of prose. A recently published review in Contemporary Educational Psychology cautions the reader that "no clear-cut recommendations can be made to educational technologists and practitioners regarding the placement of adjunct questions in text materials (Rickards, 1977)."

This placement of questions issue warrants a closer look into the theoretical underpinnings. Gagné (1973) has summarized Frase's viewpoint concerning the difference between pre/post questions. Prequestions activate search, selection, and coding strategies that encourage the retention of highly specific facts, whereas, postquestions encourage more general learning of the material. As Bull (1973)

hypothesizes, discriminative stimuli precede attentive responses to the passages and serve as arousal cues for specific stimuli, which is consonant with what Frase (1973) and Boyd (1973) advocate as a "selective attention model." The former theorizes that incidental learning is reduced when using questions prior to selected portions (prequestions), due to adoption of a search strategy that excludes any information beyond that which must be processed in order to answer the prequestion. Therefore, it might be concluded that incidental information is screened from the reading.

The focus on postquestions seems to attract more interest among researchers. Bull (1973) suggests that the question is the discriminative stimulus for the attentive response; the reader is reinforced for paying attention and inputting the information.

Frase (1968) and subsequent researchers propose two explanations for effects of postquestions: a backward (review) effect, and a forward (shaping) effect. In the backward effect, participants are forced to mentally review the material in order to answer the question; hence, a search includes both intentional and incidental information, which strengthens the probability of later recall on the criterion measure. Empirical data reported by McGaw & Grotelueschen (1972), Rothkopf & Billington (1974), and Rothkopf & Bisbicos (1967) support the backward (review) hypothesis. Further, Ausubel (1963) speaks of postquestions as reviews to reduce interference and promote the process of integrative reconciliation.

The forward influence or shaping hypothesis was investigated, but not supported, by Watts & Anderson (1971). In this situation, inserted questions provide a guide for adjusting study behavior on succeeding passages. According to this shaping hypothesis, the behavior subsequent to the inserted questions is modified, and the later passages are processed or attended to in a different fashion. As Mayer (1975) mentions, this forward influence may establish what Gagné refers to as performance sets (expectancies) based on prior test-like events.

Before any substantial conclusions can be drawn regarding the position of questions, additional research must be conducted. Rickards (1977) suggests that the overall conceptual framework from which the various levels and types of questions (discussed later in this paper) should be operationally defined and then systematically examined under a variety of conditions.

In sum, after completing a recent review of adjunct question studies, Wittrock and Lumsdaine (1977) conclude that "the hypotheses currently advanced to explain the effects of postquestions by retroactive or backward working rehearsal or retrieval processes are not conclusively supported by the data at this time. With prequestions, the studies support a selective attention model." (p. 420)

The reader may recall that the introduction to this section heavily supports an information-processing model to serve as an umbrella for the constructs which have been discussed thus far. The information-processing model appears next in this paper.

The Information-Processing Model

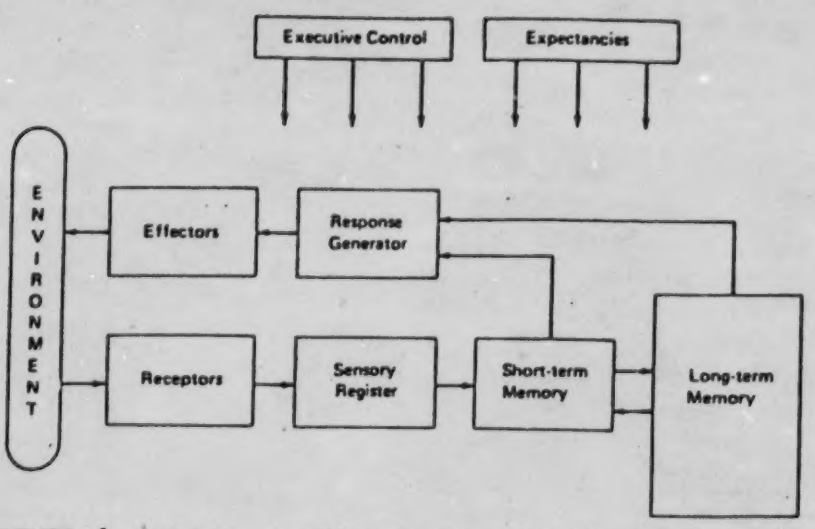


FIGURE 1 Model employed by information-processing theories of learning and memory. (From R. M. Gagné, *Essentials of learning for instruction*. Copyright © 1974 by The Dryden Press, a division of Holt, Rinehart and Winston.

Gagné (1977) summarizes the flow of information-processing as follows:

> Stimulation from the learner's environment activates receptors to produce patterns of neural impulses. These patterns persist in the sensory register for a brief interval (some hundreths of a second), from which they may be processed by selective perception into perceived objects and object qualities, or features. This "information" may then be stored in

> short term memory as auditory, articulatory, or visual images, which are subject to rehearsal. As input to long term memory, the information is semantically (or meaningfully) encoded, and then stored in this form. Processes of search may be instituted, followed by the process of retrieval. At this point, the information may be returned to the short term memory, which is conceived as a "working memory." From this structure, or directly from the long term memory, the response generator is brought into play to generate a suitable response organization. The signal flow from this structure activates effectors which exhibit the human performance. Feedback is provided via the learner's observations of this performance, and the phenomenon of reinforcement establishes the learned entities as capabilities available for future recall, exercise, and use. (p. 57)

In conjunction with his information-processing model, Gagné (1977) postulated that learning is modified and regulated by some internal processes called executive controls (see Figure 1).

These processes serve to select, modify, and control the processing that is implemented by the learner in attending, perceiving, encoding, retrieving, generalizing, and organizing responses, all of which comprise learning.

A popular goal in educational circles is teaching learners how to learn; that is, enabling the learner to exercise control over his learning. The studies in this review explore the use of executive control skills in attending to and perceiving designated parts of printed passages in hopes that positive mathemagenic behaviors take place.

The experiments analyzed in this paper involve the use of adjunct questions which are interspersed either prior to or following written passages, and are designed to activate a strategy of attending to facts of a particular category. Results, in some cases, do indicate that learners are able to exercise control over their own attention in text learning through the use of cognitive strategies. In this manner, learners utilize an executive control process to direct their own attention, and to selectively perceive portions of materials being read (Gagné, 1977).

Previously mentioned expectancies (performance sets) are credited with major responsibilities for learning, since the attention of the learner is directed, how encoding takes place, how information is retrieved, and responses result

are related to the operation of the executive control processes which include expectancies. Thus, the effect of positive or negative mathemagenic behaviors is influenced by the executive control processes within a learner.

The information-processing model as described by Gagné (1977) and illustrated in Figure 1, is somewhat different from the model which Barry (1974) uses to account for a greatly desired theoretical underpinning related to mathemagenic processes. It should be mentioned that the information-processing models discussed in this paper are extensions of an original model generated by Atkinson & Shiffrin in 1971.

A cybernetic control of learning model was described by Frase in 1969, and served as a forerunner to Barry's work. Readers who wish to obtain additional insight into these information-processing models should consult Gagné's work (1977) or that of Klatzky (1975), both of which treat the subject in a manner which enables even neophytes to comprehend the details of the information-processing models.

Using part of the model previously described, Barry (1974) theorizes that test-like questions <u>after</u> reading are held in the working memory (short term memory) and activate associated material in the long term memory (stored material from reading the text). Further, Barry contends that the activated material in the long term memory is transferred

to the short term memory, which constitutes rehearsal of the content, thus facilitating general performance. In contrast, a test-like question before reading, enters the short term memory and activates associated material in the permanent long term memory, and the difference is that this time only prior, narrow association can be activated, which results in question-specific facilitation only. Other researchers appear to concur with this hypothesis (Anderson, 1973; Rothkopf & Billington, 1974).

While Barry emphasizes rehearsal, encoding, and control processes, he does not elaborate as much as Gagné regarding the control processes, and hence the reader may wish to consult Gagné (1977) for greater depth concerning executive controls (strategies) employed in the process.

Before closing this section regarding general theoretical framework for the review, it should be pointed out that additional theories do exist. For example, Collins and Lofts (1975) propose a "spreading activation" theory which assumes that when an item is processed, other items are activated to the extent that they are closely related to that item. That is, retrieving one category member produces a spread of activation to other category members, facilitating their later retrieval. This theory is based upon the original work by Quillian (1967) in which it was assumed that activation decreases over time and/or intervening activity, which is analogous to what Klatzky

(1975) refers to as "decay" in her description of an information-processing model, and what Rothkopf (1970) infers to take place during deterioration of mathemagenic behaviors. Collins and Lofts (1975) account for this activation decrease by hypothesizing that the more concepts that are primed, the less each will be primed; fatigue takes place. Thus, the longer a concept is continually processed, either by reading, hearing, or rehearsing it, the longer activation continues.

Based, in part, on the preceding material, the author of this paper believes that a basic information-processing model encompasses the fragments of theoretical constructs which are found in the literature in attempting to provide framework for mathemagenic activities. Therefore, this writer again emhasizes an umbrella of information-processing theory under which all other hypotheses may fall. A quick review of Barry's (1974) postulates, previously presented in this paper, automatically come to mind upon reading the spreading activation theory proposed by Collins and Lofts (1975). To be more specific, the activation of associated material in the long term memory is most likely what is meant by the "spreading activation" effect; thus, directly relating to the information processing model, but with different labels.

The list of theories could continue, but would not provide additional light on the problem to be addressed in this review. Further, other theories have been proposed,

but their original investigators have been unable to verify them. For example, such additional theories might include learning to learn (Postman, Burns & Hasher, 1970) and inhibition reduction (Walker, 1974).

A reflecting glance through this theoretical section reminds the reader of the contents. First, the purpose of an instructional sequence was discussed, which emphasizes the relevant stimuli necessary to activate a performance set (expectancy) within the learner, which may, indeed, be in the form of orienting questions. Next, the pre/post question controversy was examined, which included a selection-attention and shaping model for prequestions, and for post (backward) questions included a review effect hypothesis. It is recommended (Rickards, 1977) that until additional data provide keener insights and consistencies, no conclusions should be made as to placement of questions. Finally, the information-processing model was presented which has been expanded and interpreted by Gagné (1977), and emphasizes executive control processes which govern strategies within the individual. The author of this paper suggests that this information-processing model is in fact, a superordinate model, under which the mathemagenic constructs hypothesized by other reasearchers may be subsumed.

Specific Theoretical Framework Relating to Each Variable Selected for Investigation

The historical background, the problem statement section, and the general theoretical framework provide a solid foundation upon which the remainder of this paper is based. Now that identification of the three major variables to be addressed in this review has taken place, the author wishes to apply Ausubel's (1963) construct of "progressive differentiation" by providing more specific theoretical framework for each variable being investigated, age, ability, and the level of question.

Age

The majority of the studies concerning adjunct questions involve either high school or college students as participants. Many assumptions can be made about individuals as they increase in age, such as an improvement in reading skills. Thus, although a paucity of studies exists using young learners in adjunct questions experiments, the concern of the influence of these test-like items for less sophisticated readers, due to age, is raised. Does mathemagenic behavior take place, which affects the strategies in young learners?

With a thrust toward teaching learners how to learn, educators are naturally interested in appropriate age levels in which these strategies can be addressed. Learning theorists such as Gagné (1977) advocate investigation of what cognitive strategies (also called executive controls in his information-processing model, due to management of internal processes) are available to young children, and how these strategies develop with increasing age.

Although cognitive strategies in children are being studied, (Salatas & Flavell, 1976), the search for experiments involving the use of adjunct questions with young children shows an abyss in the literature. A closer look into the previously mentioned study conducted by Salatas and Flavell (1976), reveals data which indicate that kindergarten, third grade, and college students can exercise flexible control over their retrieval strategies after receiving instructions as to the recommended use of various cues for search and retrieval processes. It should be noted that in this study the participants were taught algorithms to a mastery level, prior to the experiment which greatly differs from the typical adjunct questions study in which the learners are most frequently not provided with recommended strategies; in fact, rarely are the participants even consulted during a debriefing session (also nonexistent) as to the types of strategies which were utilized in order to respond to the questions. Although it proved to be of little value with the kindergartners and third graders, these

participants were consulted after the experiment as to how they performed their mental retrievals.

Experimental work by Brown (1973) prompted Salatas and Flavell (1975) to continue in the area of children's retrieval strategies. In essence, Brown (1973) assessed a child's ability to utilize cues in a retrieval strategy, and she concluded that spontaneous efficient use of retrieval cues increases with age.

It seems that the word "spontaneous" is the key to these studies. Salatas and Flavell (1976) found that in their experiment, kindergartners and third graders did not use a search strategy spontaneously, whereas, the college students did. It was demonstrated, however, that when explicitly prompted, the kindergartners and third graders could utilize the retrieval strategies which they had been previously taught for this experiment. Later, the youngsters began to use these retrieval cue strategies spontaneously.

An interesting hypothesis that emerged from their work is that overt, rather than covert searching is better for children, due to loss in orientation to a task during covert searching.

Thus, it appears that young learners can be taught to exercise control over their cognitive strategies; however, it seems that young learners must be reminded to use

particular strategies when assigned a retrieval task. In order to pursue the empirical data concerning use of cognitive strategies in children, this review examines several of the few available studies involving adjunct questions with young learners.

Other studies suggest that young learners react differently to inspection control devices emphasizing more than one level of learning, but that factual information can be enhanced with the use of contextual preinformation (Gagné & Wiegand, 1970). Still others (Halstead, 1973; Swenson & Kulhavy, 1974) hypothesize that youngsters disregard incidental information when specific cueing devices are available to them (adjunct questions) which results from an attenuated span or lack of strongly formed reading behaviors. Thus, Swenson & Kulhavy (1974) conclude that some students may be too young to evoke searching strategies through the use of adjunct questions.

Ability

The findings from some studies conducted with different ability groups are inconsistent. Sanders (1970) and Halstead (1973) found that high ability students benefit more from the use of adjunct questions than low ability students. In contrast, Shavelson et all (1974) report data to support facilitating effects for low ability students. Questions arise in several areas: how do the researchers define ability, what instruments are used to assess ability, and what are the ranges for

classifying students as either high or low in regard to ability?

Shavelson (1974) attempted to clarify what is meant by "ability" which he parenthetically refers to as "intelligence." It seems as if most researchers concur with Popham (1975, p 92), who states that "the most important ingredient of aptitude tests is that they permit one to make reasonably accurate predictions regarding how well an individual will perform at some future time." The types of instruments employed for assessment of student abilities in the studies reviewed for this paper represent quite a diversity. Sanders (1973) used Grade Point Averages; Hiller (1974) used American College Testing Program; Halstead (1973) used modified cloze reading comprehension tests; and Hershberger (1964) used California Achievement Tests.

One observation made by this author is the fact that few studies indicate what criterion is implemented in order to classify students as either low or high ability individuals. Furman (1974) states that for his college freshmen study using adjunct questions, students assessed at grades 7-10 reading levels constitute low ability groups; whereas, grades 11-14 reading levels comprise high ability groups.

In spite of the manner in which ability levels are determined, Shavelson et all (1974) hypothesized that adjunct questions may be of benefit to low ability students,

due to a "compensatory effect which provides additional rehearsal or organization. This theory is in concert with Salomon's three aptitude-treatment interaction models (1972): compensatory, remedial, and preferential. More specifically, (p 333), Salomon states that "too much spoon feeding and redundancy are not good for high aptitude scorers." Shavelson (1974) further elaborates by suggesting that adjunct questions may cause interference with information-processing systems of high ability learners, and thus result in a debilitating, rather than facilitating effect. The terminology in this area of research has been expanded with the addition of Shavelson's term, "mathemathanic" which "kills learning" rather than giving birth to learning, as in mathemagenic behavior.

In opposition to Shavelson, other researchers hypothesize that adjunct questions do benefit high ability students, (Halstead, 1973; Sanders, 1970) and advocate the theory that test-like events act as reviews for factual information to be learned.

Keeping the age variable in mind, a comment concerning young learners and ability levels is in order. Wittrock and Lumsdaine (1977) postulate that comprehension, which involves the use of strategies or the production of mediators, is more difficult for some children than others. They report that the research implies that children with poor conceptual

ability profit from instruction when the conceptual organization of the information is made explicit and is given to them. Children of poor conceptual ability sometimes can be taught to produce mediators and to use strategies that facilitate comprehension. For purposes of this paper, the strategies proposed by Wittrock and Lumsdaine (1977) are considered to be adjunct questions. Their viewpoint that low ability learners benefit from explicit conceptual organization is in agreement with Halstead (1973) and Sanders (1973), and further elaborates the theoretical constructs of Salatas and Flavell(1976) which appear in a previous section of this paper.

Level of Question

In 1973, Gagné asked, "Can different types of interspersed questions induce different types of intellectual processing of the material studied, including 'thought-inducing' or higher level processing, as opposed to simple factual retention?" (p. 16)

Frase (1969) and his counterparts hypothesize that a learner adopts approriate strategies in learning from printed material which is adaptive in response to internal criteria of what he/she intends to learn. Frase found that "higher level processing" produced by "orienting directions," raised the general level of recall.

As in the case of much research, inconsistency and

confusion result due to differences in definitions of terms. For example, Watts and Anderson (1971) define question levels as follows: higher order questions include comprehension and application of facts, rules, principles, and concepts; whereas, lower order questions include recognition and recall of factual information. This viewpoint appears to be in agreement with two different types of learning outcomes postulated by Gagné (1972) where the higher order questions are comparable to what he terms, "intellectual skills," which enable an individual to interact with his/her environment using symbols as exemplified in reading and writing: and the lower order questions are analogous to verbal information (recall of facts). It should be noted that the majority of the adjunct question research addresses the latter, that is, recall of facts within prose material. The difference between the two categories (higher and lower questions), is that higher order questions require the learner to transform information, and then use it, while lower order questions simply require recall of the information.

A study conducted by Felker & Dapra (1975) further highlights inconsistency in definitions, as indicated by the superior level questions quite similar to verbatim questions in that they were directed toward only one or two sentences per question.

In contrast, however, Rickards (1976) used higher level questions to represent conceptual questions including infor-

mation related to an entire paragraph of four sentences. His hypothesis inferred that retrieval of four text sentences per conceptual postquestion appeared to overtax the processing capabilities of the learner.

When categorizing questions according to Bloom's taxonomy, (high level including application and analysis levels; low level including knowledge and comprehension), Furman (1973) refers to Gagné's work to explain the reason low level items are retained better than high level items, which is that skills of analysis and application cannot be acquired from books alone. In order to acquire these intellectual skills, the conditions of learning necessitate actual involvement and manipulation of the skills by the learner (Gagné, 1970).

The inability to generalize results or form conclusions is quite apparent due to the variation in definitions of the levels of questions included in the studies.

Theoretically, during a mental rehearsal process, information in the short term memory (working memory) is transferred into long term, or semantic memory. It may be that various types of processing; that is, questions requiring recall of facts only require superficial processing, while questions necessitating application of rules demand deeper level semantic processing (Anderson & Biddle, 1975; Halstead, 1975). Thus, the encoding and rehearsal of information have a direct bearing on what is to be learned, as

does the strategy used for later search and retrieval during administration of the criterion measure.

Further, Mayer (1975) hypothesizes that different kinds of cues for establishing learning sets result in different types of learning outcomes. This is substantiated, and concurs with the studies of several others who conclude that higher order questions contribute to better overall performance on all question types, than do lower order questions (Felker & Dapra, 1975; Halstead, 1975; Rickards & DiVesta, 1974; Watts & Anderson,1971).

Thus, in regard to level of question, Frase (1970) summarizes the results from the empirical data he has collected by stating that learning behaviors may be modified in accordance with the amount of information that may be processed.

In retrospect, the reader is now acquainted with specific theoretical constructs that directly relate to each of the selected variables (age, ability, and level of question). Although a sparcity of studies may be found involving young learners using adjunct questions, many theorists hypothesize that young children not only process information differently than older children, but also, the young learners do not spontaneously use retrieval cue strategies, even when a specific strategy has been previously taught and mastered by them.

Regarding ability of the learners, some researchers hypothesize that high ability students experience interference within their processing systems when using adjunct questions, and thus, find them debilitating (Shavelson et all; 1974) whereas, low ability students experience a compensating effect of adjunct questions which provides additional rehearsal or organization (Salomon, 1974). At the other end of the spectrum lies the belief that high ability students benefit from adjunct questions due to this review process for factual information to be learned (Halstead,1973; Sanders; 1973).

And finally, the level of question, which is yet to be consistently defined, may affect the type of mental processing in that factual recall (low level) merely requires superficial processing, and application of rules (higher level) requires deeper processing. Thus, the encoding and rehearsal of information for storage have a direct relation on what is to be learned, as well as the strategy used for later retrieval.

Table 1

Composite of 20 Experimental Studies Using Adjunct Questions, with Specific Regard to Age, Ability, Question Level, and Other Variables

Author/Year	Participants: Age (Grade)	Participants: N	Participants: Selection	Ability Levels	Adj. Questions: Position	Adj. Questions: Levels	Passage: Length	Passage: Content	Feed-Back	Study Time Control	Results: Intentional/ Incidental	Results: * $p < .05$, ** $p < .01$, A.Q.= Adjunct Questions
Hershberger, 1964	5th grade	160	intact classes	high/ low	Post		3,500	Blood; Texas	No	No	*/NSD	Self-evaluative response group scores doubled those of control group on intentional, but nonsignificant difference on incidental lrng. Low ability students benefit from use of A.Q. when using a terse textual format; whereas high ability students benefit from either AQ or terse textual format, but not both.
Swenson & Kulhavy, 1974	5th & 6th	109	intact classes		pre/post	verbatim/ paraphrsd	1,320	Island of Ako		No	**/NSD	Post AQ facilitated intent. lrng., but debilitated incidental lrng (although NSD). During 1 wk. delayed retent. test, post AQ facilitated lrng. ** level.
Kroll, 1974	5th & 6th	120	randomly selected	high/ low	post	easy/ difficult/ creative	28 pgs. or 30 min	How Scientists Work		No	NSD/NSD	Two modes of treatments (written/audio) Poor readers in this study were not superior listeners (maybe results were due to inexperience with audio equipment) No control group.
Halstead, 1975	6th grade	122	intact classes	high/ low	post	facts/ rules/ concepts	6 pgs.	New Planet	Yes	No	NSD/NSD	A.Q. facilitated (although NSD) $^{int.}_{\wedge}$lrng. for high ability students (above 75% rdg. comp. level) but failed to facil. for low groups. Incid. lrng. not affected for either group.
Wadsworth & Flagg, 1971	6th grade/ college	113 74			post			Latin Am/ Whales	Yes	No	NSD/NSD	Both age levels were given same materials. No facilitating effects observed from use of AQ when immediately tested. However, 1 wk retention test revealed ** supporting AQ, but only for transfer items for both ages.

55

Table 1

Composite of 20 Experimental Studies Using Adjunct Questions, with Specific Regard to Age, Ability, Question Level, and Other Variables

Author/Year	Participants			Ability	Adj. Questions		Passage		Feed-Back	Study Time Control	Results	
	Age (Grade)	N	Selection	Levels	Position	Levels	Length	Content			Intentional/ Incidental	* $p < .05$ ** $p < .01$ A.Q. = Adjunct Questions
Yost, 1970	7th grade	196	intact classes		post	high/ low	250 PI frames	Science Levers	Yes	No	**/ **	High level complex questions were superior in both inten. and incid. lrng. Students told marking period grade would depend on treatment performance.
Hesse & Smith, 1974	9th grade	296	intact		pre/ post	factual/ evaluate content/ process	3,500	Biog. of Nuclear Scientist		No	NSD/ NSD	Literal comprehension of passage was not affected by quest. level, type, nor location.
Allen, 1970	9th grade	212	intact	high/ low	post/ adv. org.	high/ memory	1045-1710	Asia		No	NSD/ NSD	High ability=above 60th %tile on Lorge Thorndike Verbal Intelligence Test; low=20th-59th%tile. Higher order quest. did not facil. intent. lrng. nor incid. However, adv. org. were better for high ability students; whereas, A.Q. were better for low.

Table 1

Composite of 20 Experimental Studies Using Adjunct Questions, with Specific Regard to Age, Ability, Question Level, and Other Variables

Author/Year	Participants			Ability	Adj. Questions		Passage		Feed-Back	Study Time Control	Results	
	Age (Grade)	N	Selection	Levels	Position	Levels	Length	Content			Intentional/ Incidental	* $p < .05$ ** $p < .01$
Lucking, 1975	10th grade	84	intact classes	high/ low	post			Short Stories		No	*	Questions were hierchically ordered. AQ group resulted in signficant diff. superior to control group in performance and attitude.
Wagner, 1976	10, 11, 12th grades	240	intact		post	recall/ applic.	2,250	Psych. Principles		No	** *	Multiple choice AQ were better for recall (low) levels; whereas, fill-ins were better for application levels. Criterion measures were 1 wk. delayed retention tests (no immed).
Rothkopf & Bisbicos, 1967	10,11,12 th	252	paid volunteers		pre/ post	verbatim/ compreh.		Learning Reinforcement		No	*	Comprehension levels questions were superior in intent. lrng. , but NSD between pre/post locations.
Watts & Anderson, 1971	12th grad-	300	intact		post	repeated example/ applic./ name only	2,250	Psych. Principles		No	**	Application AQ performed better than all groups. Control group performed better than name only.

Table 1

Composite of 20 Experimental Studies Using Adjunct Questions, with Specific Regard to Age, Ability, Question Level, and Other Variables

Author/Year	Participants: Age (Grade)	Participants: N	Participants: Selection	Ability Levels	Adj. Questions: Position	Adj. Questions: Levels	Passage: Length	Passage: Content	Feed-Back	Study Time Control	Results: Intentional/Incidental (* p < .05, ** p < .01; A.Q. = Adjunct Questions)
Furman, 1974	College Freshmen	124	intact classes, (random)	high/low	post	high/low	1,525	Lisbon Earthquake	No	No	** Control group did better than AQ groups, both written and oral. Written did ** better than oral group. Low ability students benefit more than high ability students using A.Q.
Shavelson et al, 1974	Junior college	87	paid volunteer	high/low	pre/post	high/low	1,525	Lisbon Earth-Quake	Yes	No	*/* Higher level post question group did better (sign.) than lower level and control. Higher level quest. aid low level vocab. students, but interferes with processing of high level voc. st. Lower order questions did not facil. learning.
Sanders, 1973	College	72	volunteer	high/low	pre/post	compreh/knowldg.	2,000	Biog. of Wm. James		No	NSD/NSD Post questions were superior for high ability (NSD). No differences on modes (reading/listening).
Koran & Koran, 1975	College	93	intact classes (course requirement)	high/low	post		5,000	Marine Biology		No	.001/NSD Frequent questions benefit low ability students; compensate for lack of attention directing and control. Infrequent question group outperformed frequent question group. AQ facilitate intentional learning, but not incidental learning.
Rickards & DiVesta, 1974	College	80	volunteer (recd. course credit)		post	rote fact rote idea task unrelated meaningful lrng	800	"Mala" African nation			**/* Meaningful learning questions were significantly superior to other levels regarding both intentional and incidental learning. Meaningful lrng. level produced backward (review) effect; fact learning, forward effect. AQ spaced far apart depressed learning (cognitive strain).

Table 1

Composite of 20 Experimental Studies Using Adjunct Questions, with Specific Regard to Age, Ability, Question Level, and Other Variables

Author/Year	Participants: Age (Grade)	Participants: N	Participants: Selection	Ability Levels	Adj. Questions: Position	Adj. Questions: Levels	Passage: Length	Passage: Content	Feed-Back	Study Time Control	Results: Intentional/Incidental	Results: * $p < .05$, ** $p < .01$, A.Q. = Adjunct Questions
Frase, 1973	College	48	Intact classes (course requirement)		pre	attribute superordinate name		Nautical information		No	NSD/NSD	"Attribute only" group recalled more than "superord. name only" group. Intentional lrng. greater than incidental. Criterion measure unexpected for learners. Supports selective attention hypothesis for pre AQ (intentional but not incidental).
Mayer, 1975	College	80	Intact classes (course requirement)		pre/post	define calculate apply model	8 typed pages	Math. probability	No	No	NSD/NSD	No difference between students who answered AQ and those who merely read them. "Define" and "calculate" groups performed poorer than control group. Group that applied model outperformed all groups.
Felker & Dapra, 1975	College	95	Intact classes		pre/post	verbatim comprehension		Learning Reinforcement Theory		No	*/NSD	"Comprehension" group performed significantly superior using post AQ. Control group outperformed prequestion group. However, these authors define comprehension as paraphrasing. Higher order questions were superior for overall performance.

Critical Analysis of Twenty Experimental Studies Using Adjunct Questions with Specific Regard for Age and Ability of the Learner, and Question Level

In this section of the paper twenty experimental studies, conducted between 1964 and 1977, which address the selected variables of age and ability of the learners, and level of questions are examined. The studies, which attempt to support the various hypotheses promulgated by the respective researchers, are analyzed. The first variable to be examined is the age of the participants in the experiments.

Age (in terms of grade level)

For organizational purposes, the author proposes the classification system in Table 2 which enables one to compare and contrast the results among the studies. The ranges of sample sizes within the categories are included in the far right column, and are discussed throughout this section of the paper.

Table 2

Classification of Experimental Studies According to Grade Levels

Category	Grade Level	Range of Sample Sizes
Elementary	5-6th	109-160
Intermediate	7-9th	192-296
High School	10-12th	240-300
College	Fr.-Sr.	48-700

Each category, in turn, is presented in regard to the procedures and results of the data collection in the selected studies.

Elementary. Analysis of the five experimental studies (see Table 1) which involve elementary school children reveals that the use of post adjunct questions can facilitate intentional learning, but does not influence incidental learning; however, it should be noted that a predetermined level of significance was obtained in only two of the five studies. These five studies involved either 5th or 6th graders, and were conducted with "intact" classes, thus eliminating the possibility of artifacts due to "volunteer participants." As indicated in the classification system (Table 2), the range of samples encompassed 109-160 participants.

With the exception of Halstead (1975), the treatment materials consisted of verbal information (factual recall), and did not include any indication of procedures to determine the reliability and validity of the treatments. Further, one study employed an 8th grade text for a 5th grade sample (Hershberger, 1964), whose reading score ranges as indicated on the California Achievement Test were 7.2-7.3.

In one of the five studies involving elementary school children, a pretest was administered to determine previous exposure to the passages (Hershberger, 1964). The investigator carefully prevented the artifact of pretest sensitization by allowing 14 days to elapse between the administration of the pretest and the actual conduct of the experiment. Furthermore, the Hershberger study is one of the few studies that identified

the individual who conducted the experiment, which is in this case, the regular classroom teacher. The absence of information concerning who conducted the experiments (regular classroom teachers, graduate assistants, other experimenters, or the investigators) in the other studies raises the question of the possibility of artifacts, such as experimenter expectation, or evaluation apprehension, to occur.

Thus, although a dearth of studies exist in which elementary school children are included as participants, the consensus appears to support the use of post adjunct questions to facilitate intentional learning. However, the amount of achieved incidental learning, which is of greater interest to some researchers, such as Rothkopf (1970), does not appear to be significantly influenced as a result of using these test-like items. One researcher conluded that when children are given special cueing devices, they disregard incidental information while attending only toward the information addressed in the question (intentional learning); thus, control of inspection behavior may differ with age, due to internal processing capabilities (Swenson & Kulhavy, 1974). Implications of this outcome are discussed in a later section of this paper.

Intermediate. Three studies involved intermediate grade level participants (Allen, 1970; Heese & Smith, 1974; Yost, 1970). Two of these studies revealed a nonsignificant difference in immediate recall of intentional and incidental information as a result of using post adjunct questions, whereas, the third (Yost, 1970) found a significant difference in both intentional and incidental learning when using high complex level adjunct

questions. (Note that the levels of adjunct questions are addressed in a subsequent section of this review.)

Although it is premature to address the variable of ability, the reader should be informed that the Yost study employed participants who averaged 108.6 on the Henman-Nelson Test of Mentality, which is above the norm.

The only other significant difference appearing in the intermediate category is the result of a three week retention test that was administered to high ability students who originally were unable to correctly respond to the immediate criterion test, but were able to answer the questions three weeks later. This phenomenon has been referred to as the "sleeper effect" (Allen, 1970). It should be mentioned that there is a possibility that due to the motivation of higher ability students, it may just be that the participants later investigated the correct answers which they were unable to achieve during the immediate test, thus, preparing themselves for the anticipated three week retention test. Absence of control during the three week interlude makes this quite plausible.

High School. Three studies examined involved high school students (Rothkopf & Bisbicos, 1967; Wagner, 1976; Watts & Anderson, 1971). Each study reported a significant difference supporting the use of post adjunct questions for intentional learning, but not for incidental learning. A closer look reveals other areas in which these studies differ from those previously mentioned. For example, Rothkopf & Bisbicos used paid volunteers from grades 10-12; Watts & Anderson used a

sample size of 300, and finally, Wagner only administered a one week delayed criterion retention test without any type of immediate criterion measure.

College. Nine studies involving college students are presented in Table 1 with samples ranging from 48-700 participants. Four of these studies reveal a significant difference favoring post adjunct questions for intentional learning. One study (Furman, 1974) reports a significant difference with a control group superior in performance, and the remaining studies indicate nonsignificant differences when using adjunct questions.

It is noted that two of the four studies evidencing the benefit of adjunct questions at a significant level involved participants who were either paid or received course credit for their involvement in the experiment. Further, these same two studies which involved the volunteers who were compensated in some manner, are the only two studies involving college students which resulted in a significant difference in the amount of incidental learning as a positive result of post adjunct questions. It may be possible that an artifact biased the results in that the participants were more highly motivated due to having received compensation. Further, in these same two studies (Shavelson, Berliner, Ravitch, & Loeding,1974; Rickards & DiVesta, 1974) the participants were provided with explicit details concerning the experimental purposes (to study human learning and memory) prior to the administration of the treatments.

This explicit direction procedure is in contrast with the remaining experiments in which the participants were not given

such elaborate details. It may be that in or by following the directions, artifacts took place; that is, perhaps demand characteristics were present among the students, or even a trace of the experimenter expectation could have evolved. The compensation aspect suggests the artifact of evaluator apprehension, since the students were paid or rewarded in either a monetary form or course credit, and consequently, not only were motivated to learn the intentional materials, but also, the incidental information found within the passages.

When a control group excells in performance over an experimental group, there is cause for further investigation as reported in Furman's study in 1974. Examination of the report showed that although the treatment passage, "Lisbon Earthquake," was validated in a previous study, the material was too difficult for 50% of the present sample to master. Although no evidence of any type of pilot test for this sample is found in the Furman report, a different study (Shavelson, Berliner, Ravitch, & Loeding, 1974) incorporated the same materials, conducted a pilot test, and later observed a significant difference in both intentional and incental learning as a result of using adjunct questions. This emphasizes the importance of conducting pilot studies or other types of formative evaluation with representatives from the target population, prior to the actual experiment. For example, in Furman's study the inability of 50% of the participants to master the materials may have been detected with an earlier pilot study using members of his target population from which the sample was drawn. In accordance with the results of the

pilot study, revisions could have been made to prevent such a large number of students failing to master the materials.

In the Furman study (1974) perhaps frustration caused by the difficulty of the materials, may account for the fact that the control group outperformed the experimental group. Moreover, the frustration level may have been further raised because the participants were not informed of the correct answers to the questions; thus, without feedback, the students might have been unable or unwilling to modify their strategies, and did not really benefit from the use of adjunct questions.

In sum, in the studies examined, as age and sample size increased, the amount of significant differences resulting from the use of adjunct questions also increased. Comparison of group means of nonsignificant studies in most cases reveals superior performance when post adjunct questions are interspersed within the passage. However, it is important that the reader of a report remembers the purpose of significance levels; that is, a researcher should not establish a level of significance and after failing to reach a significant difference proceed to make concluding remarks when only considering the group mean differences and ignoring the predetermined levels. Therefore, many of these studies reveal differences among the groups, and most favoring the use of adjunct questions. However, very few can be considered to be "significant differences" in the statistical term, which is often deemphasized by the anxious researcher when reporting his/her data.

This reviewer notes that volunteer participants were

frequently included in college studies, but were totally absent from the lower grade levels. Therefore, it may be speculated that inclusion of volunteer participants may influence the outcome of the experiment, which might, in turn, begin to account for the increase of significant differences.

It is further possible that the artifacts of evaluation apprehension or even experimenter expectation (Rosental & Rosnow, 1969) may have been present in some of the studies in which volunteer participants were either paid or received course credit for their involvement.

Ability

Although nine of the twenty studies which were analyzed reported the ability levels of the samples, interpretation problems evolve in two areas: the diversity of the instruments, and the absence of designated ranges of ability within the studies. Examination of Table 3 shows that seven different instruments were used to determine the ability level of the participants which imposes limitations on the generalizations which may be applied to the studies when considering them as a group. The instruments used differed with respect to measurement of reading ability, general verbal intelligence, anxiety tests, grade point averages, and several other factors. One study neglected to report the type of instrument used. Further, only three of the nine studies included the reliability of the instrument.

A critical exclusion in five of the studies which address ability as variables is noted. The researchers did not indicate

Table 3

Adjunct Question Studies Using Ability Level of Participants as a Variable

Author/Year	Grade	Ability Groups	Instrument	Reliability	Ranges for Classification
Hershberger, 1964	5th	High Low	California Achievement	Not available	Not available
Kroll, 1974	5/6th	High Low	Stanford Achievement Reading Test	Not available	H=above school median L=below school median
Halstead, 1975	6th	High Low	Cloze Reading Tests	Not available	H=above 75% L=below 75%
Lucking, 1975	10th	High Low	Not available	Not available	Not available
Allen, 1970	12th	High Low	Lorge Thorndike Verbal Intelligence	Not available	H=above 60%ile L=20-59%ile
Furman, 1974	College	High Low	Nelson Denny Reading Test	.93	H=11-14 level L=7-10 level
Shavelson, et al 1974	College	High Low	French, Ekstrom Battery; Taylor Manifest Anxiety	.85	Not available
Sanders, 1973	College	High Low	Grade Point Average	Not available	Not available
Koran & Koran, 1975	College	High Low	French, Ekstrom Battery	.85	Not available

the ranges which encompassed the ability groups, failing to clarify exactly what they meant by "high ability" or by "low ability." Fortunately, several of the studies did report this variable in terms of reading grade levels, median scores, or percentiles on standard achievement tests (see Table 3).

It can be seen that the results of the studies are as diverse as the instruments utilized to assess the ability levels. Looking back at Table 1, it may be noted that there is inconsistency among results and conclusions. For example, Halstead (1975) and Sanders (1973) recommend the use of adjunct questions for high ability students, whereas, Allen (1970), Furman (1974), Hershberger (1964), Koran & Koran (1975), and Shavelson et al (1974) recommend the use of adjunct questions for low ability students. In addition to these conclusions, Lucking (1975) favors the use of adjunct questions for any ability level.

Two of the researchers stress the fact that low ability groups within their samples encompass low socio-economic status, which is often the case among less skilled readers (Allen, 1970; Halstead, 1975).

Halstead (1975) states that students above the 75% reading comprehension level benefit from the use of these test-like items interspersed within prose passages, whereas, readers below the 75% comprehension reading level do not benefit from any assistance other than remedial work to improve their comprehension level.

The methodology incorporated in the study conducted by Allen (1970), in which participants who missed more than one of the four lessons were automatically dropped from the experiment might be questioned. Further, students who only missed one lesson were assigned an approximate score for that lesson, based on performance

in the remaining lessons which were completed. Concerns may rise with respect to the characteristics of the students who, in fact, did not complete the experiment; yet, no mention was made within the report regarding this potential validity threat, due to mortality of participants.

The researchers advocating adjunct questions for high ability learners seem to agree that the questions serve as a review process; whereas, the proponents of the test-like items for low ability students support the compensatory aptitude-treatment interaction model proposed by Salomon (1972). In essence, Salomon's model suggests that the questions "compensate" for deficiencies within low vocabulary students (Shavelson et al, 1974), but on the contrary, the questions debilitate processing on the part of high ability students by causing interference.

Thus, it appears that once again the data do not permit solid conclusions to be drawn in regard to which ability groups do and do not benefit from the use of adjunct questions. It seems that ability cannot be considered as an isolated variable, but must be thought of in conjunction with other considerations, such as level of question within the passage.

Level of Questions

The processing of information within a learner is directly affected by the level of questions posed to him/her; that is, more complex questions require deeper processing than do questions which require recall of facts. However, it is noted that the conventional studies which use adjunct questions deal with only lower order questions.

Table 4

Levels of Adjunct Questions Used in Sixteen Experimental Studies

Author, Year	Grade	Levels of Questions
Swenson & Kulhavy, 1974	5,6th	verbatim paraphrase
Kroll, 1974	5,6th	easy difficult creative
Halstead, 1975	6th	facts concepts rules
Yost, 1970	7th	high level complexity low level complexity
Hesse & Smith, 1974	9th	factual evaluative content process
Allen, 1970	9th	high memory
Wagner, 1976	10-12th	application recall
Rothkopf & Bisbicos, 1967	10-12th	comprehension verbatim
Watts & Anderson, 1971	12th	application repeated example name only
Furman, 1974	college	high (application & analysis) low (knowledge & comprehension)
Shavelson et al, 1974	college	high low
Sanders, 1973	college	comprehension knowledge

Table 4 continued

Rickards & DiVesta, 1974	college	rote learning facts rote learning ideas task unrelated (incidental) meaningful learning
Frase, 1973	college	attribute superordinate name
Mayer, 1975	college	definition calculation application of conceptual model
Felker & Dapra, 1975	college	verbatim comprehension (paraphrase)

A list of the various levels of questions appearing in the studies analyzed for this paper is presented in Table 4.

Generally, one may interpret a "high level question" to be comparable to Bloom's taxonomy wherein application and analysis are involved, and a "low level question" is basically considered knowledge and comprehension, or what Gagné would term as "verbal information" (recall of facts). (1972)

The most frequent hypothesis appears to suggest that lower order questions enable the learner to recall only facts; whereas, higher order questions facilitate not only application and analysis of the material, but also, the factually related information which is subordinate to the more complex level question. Further, it is postulated that adjunct questions enable the learner to establish categories for the information within the passage, and additional (incidental) material is learned as a result of being required to process deeper level questions which enables the learner to store and retrieve tangential information near the specific category related to the question, due to additional transformations of the information.

In accordance with the information-processing theory of learning, the more often transformations take place, and the addition of available opportunities for encoding of various forms, the more likely the information is stored and available for future retrieval due to a larger amount of cues which facilitate recall of the stored information.

With the exception of Allen (1970) and Sanders (1973), most researchers have found high level adjunct questions (general) to facilitate greater learning than specific

factual questions. Closer examination of the two studies which appear to contradict the others shows that in the Sanders study only a random sample of all of those who completed the passage were given the criterion measure. No details were provided in regard to the number taking the criterion test, nor the procedures. Further, the participants were stratified by ability, but this point was not mentioned in the discussion of the criterion measure administration.

The closer examination of the study shows that the higher order questions failed to enhance retention of factual information, which contradicts most of the remaining studies. It may be recalled that this is the study in which participants were eliminated if they missed more than one out of four lessons, and if they missed only one lesson, their score was approximated via the subsequent scores obtained in the other lessons. Another extraordinary feature of this study is a "sleeper effect" which revealed a remarkable recovery for high ability students; that is, during the immediate criterion measure, these high ability students were unable to respond to the questions; however, after a three week lapse of time, the students performed exceptionally well on the delayed retention test. In fact, they answered questions which they apparently "did not know" three weeks earlier. It may be that motivational forces drove the students to seek the correct responses to the questions, knowing that another test would be administered three weeks later. Afterall, the students could not be kept under controlled supervision at all times during the three weeks, and no attempt was made to determine whether the students

had prepared for the three week retention test.

In two of the studies the control groups produced surprising results: Watts & Anderson (1971) report that their "name only" type of questions did poorer than the control group, and Felker & Dapra (1975) found that the control group outperformed the group using prequestions. It should be noted that in the latter study the comprehension level represents merely paraphrasing the factual material, which in the eyes of Gagné (1977) would still be considered recall of verbal information. Thus, a problem again enters the scene, due to inconsistent definitions of terms among the studies.

Mayer (1975) reports that is his study, actual problem solving did not enable the students to perform any better than those who merely read the problems prior to instruction. He also concludes that students expecting low level questions are unable to answer higher level questions; thus, the use of lower level questions limited future learning.

Although obtaining significant differences which support the use of higher level adjunct questions, Rickards & DiVesta (1974) conducted a study which had several features worthy of mention: volunteers were utilized, for which the compensation was course credit (artifacts may enter here), the passage was extremely short (800 words), explicit directions were given in regard to the study and procedures, and increased spacing of adjunct questions resulted in depressed learning (comparable to what Bruner describes as cognitive strain). Yet, the results of this study revealed significant differences supporting meaningful learning level questions to facilitate both intentional and incidental learning.

Although Yost (1973) found a significant difference favoring the use of higher level questions, the fact that the participants' grades depended on the scores they received in the experiment may have introduced evaluation apprehension as an artifact.

Interaction

One of the twenty studies analyzed deserves special attention due to its exceptional design and reporting features addressing interactions among question location, level, and ability of the participants. This study, conducted by Shavelson, Berliner, Ravitch, and Loeding (1974) was designed to investigate relationships among the previously mentioned variables (ability, position and level of questions). It should be noted that these researchers (Shavelson et al) implemented proper techniques both preceding and following the actual experiment by conducting an extensive pilot study using the instruments designed to assess ability levels and the treatment materials. In both cases, the reliability coefficients were included in the report. Further, this is an exemplary study for two additional reasons: (1) prior to the experiment the participants were given explicit details concerning the purpose of the experiment, and (2) they were debriefed after the experiment in regard to the outcome and any questions which were raised by the students. In fact, the only questionable practice reported is the employment of volunteers as participants, which may have biased the results due to characteristics which often cause artifacts in research (Rosenthal & Rosnow, 1969).

The type of participants in a study must be considered before weighing the significant results of the study too heavily.

The reporting of this study included details not often found in other articles; for example, the predetermined alpha and beta levels were indicated, as were the proportions of males/females, and mean ranges within the groups. Also, this study carefully described the design which was used to investigate interactions among the location (pre/post questions), the levels (high/low comprehension) of questions, and the ability of the learners. Furthermore, elaborate instruments were designed (and validated) for the purpose of determining ability (aptitude) levels of the participants. In cases where an existing aptitude test was employed, the researchers supplied information which assisted the reader with respect to the purpose and procedure of the instrument. In total, five different aptitude instruments were used prior to the experiment.

Shavelson et al (1974) provided the reader with adequate theoretical framework in regard to types of mental processing hypothesized to take place as a result of the complexity of the question embedded within the passages. More specifically, it was postulated that a higher order question requires the ability to remember and transform information within a given text, whereas, a lower order question is merely a superficial nature, only necessitating pure recall.

Turning to the results of the study, a significant interaction between question position and level in regard to the vocabulary ability of the students is observed. Precisely stated, students with low vocabulary abilities evidenced a

facilitating effect when using post adjunct questions of higher order with respect to both intentional and incidental learning. The results of the study prompted the researchers to suggest that high vocabulary students should not be given these test-like items, due to a debilitating effect which, in fact, revealed the high ability experimental group's performance to be below that of the control group who did not use adjunct questions.

It appears that the aptitude-treatment interaction results of this study can be linked to the models proposed by Salomon (1972), whose "compensatory model," alluded to throughout this paper, suggests a facilitating effect for learners who possess deficiencies in the processing of information. Consequently, the low vocabulary students benefit via adjunct questions which serve as devices to interrelate concepts within the prose passages, in addition to acting as a review mechanism. In contrast, the high ability students are capable of processing the materials without the assistance of external devices, which in fact, may cause interference or interrupt the performance of the internal processing. In other words, these high ability students, according to Salomon, implement strategies which are extremely efficient, and any type of interference may in fact reduce the amount of learning. This brings to mind the importance of pretesting students prior to instruction. If, indeed, a learner can demonstrate mastery of certain materials, it follows that additional instruction not only is inefficient (cost and time), but also, it may be that more damage is inflicted by requiring the student to experience unnecessary instruction. Thus, it

may be inferred that it is unwise to provide redundant instruction when the learner has already demonstrated mastery level performance. The next question that arises is how does one distinguish redundancy from "review" which is frequently recommended for insurance of adequate encoding and storage of the information which may be later retrieved with expediency.

In sum, it appears that a recommended procedure for the investigation of the value of adjunct questions is to pursue the lead provided by Shavelson et al; that is, aptitude-treatment interactions may someday enable researchers to prescribe different treatments for varied abilities of the learners.

Analysis Conclusions

The analysis of the twenty experimental studies reveals many conflicting results which make arriving at solid conclusions extremely difficult, if not impossible. This portion of the paper attempts to synthesize the results of the studies, and to state some appropriate generalizations.

It might be concluded that as a learner increases in age, he/she is more capable of utilizing adjunct questions as a technique for increasing the amount of learning gained through reading a passage of prose. This is not to say that a young learner is incapable of being taught to master strategies which aid in retrieval of information, as demonstrated by Salatas & Flavell (1976). Thus, although Swenson & Kulhavy (1974) conclude that young children differ in processing strategies causing them to ignore incidental

material when given cueing devices, the question, "how can young children be provided with activities which facilitate acquisition o strategies which enable them to control their learning" remains to be answered. Perhaps, the answer lies in the fact that young children must be reminded of the strategies, prior to examining instructional material. One study (Salatas & Flavell, 1976) demonstrated that kindergartners and third graders could utilize previously mastered retrieval strategies when reminded. Therefore, it might be generalized that young children do not spontaneously use search and retrieval strategies that have been previously taught to them. This point emphasizes the importance of Gagné's event of instruction, stimulating recall of prior knowledge. However, much more research in the area of children originating their own strategies for processing verbal information is necessary.

A previously stated observation is repeated here for emphasis. Most of the studies which reported finding significant differences when adjunct questions were used are those in which the participants were compensated, with money or course credit, for their services. Inasmuch as there were no volunteer participants included in the studies involving elementary school children, the question of how the results might be influenced by the use of elementary school age volunteer participants is unanswered.

Reliable conclusions about the influence the ability of the participants may have on the results of using adjunct questions cannot be formed. However, this author cautiously interprets the results to recommend the use of these test-like items for low ability students who have the potential of

mastering the materials, and remedial work is advocated for those who do not reach desired entry level. It seems that high ability students perform well under most circumstances. One exception reported is the Shavelson study which showed that adjunct questions caused debilitating effects due to interference with the processing on the part of the more academically talented students. Perhaps, it might be best to permit superior learners to utilize their own strategies for learning prose material, rather than have them employ external devices which might adversely affect the learning outcome.

Finally, the studies do seem to approach some agreement on the level of question included within the passages; that is, higher order questions appear to facilitate an increase in the amount of learning when compared to lower order questions.

Because of the wide diversity of procedures, participants, and materials used, as well as the inconsistency of the nature of the results reported in the studies, the conclusions stated above have been reached with a considerable degree of caution. It seems appropriate now to once again examine the original objectives of this paper which provide organizational framework for implications of the analyzed studies.

Reflections on Objectives

The purpose of this portion of the paper is to certify that each of the original objectives of the study has been addressed.

The statement of the objectives serves two purposes: it stimulates recall of the objectives, and provides an advance organizer for the remaining section of the paper.

The objectives appear once again, as follows:

Objectives

The objectives of this critical analysis are to:

1. Provide a general theoretical framework encompassing the various adjunct question constructs hypothesized by researchers, and generate a specific theoretical framework for the variables addressed in this paper (age and ability of learners and level of question).

2. Develop the relationship of each variable with the information-processing model of learning theory.

3. Locate data which either support or do not support the use of adjunct questions as a means by which children and adults can, in fact, be taught to exercise control over their learning.

4. Critically examine and integrate empirical evidence concerning the effects adjunct questions have on learning from prose material in regard to the age and ability of learners and question level.

5. Indicate weaknesses and limitations in the studies which may attribute to the numerous inconsistencies in findings.

6. Examine, compare, contrast, and tabulate operational definitions of the variables and instruments used.

7. Determine whether or not data support the use of adjunct questions to increase the amount of learning (intentional

and incidental), and in what types of circumstances.

8. Provide practical suggestions as to how the adjunct questions should be used, and under what conditions.

9. Recommend areas of future research which might be investigated concerning the use of adjunct questions, and the development of strategies which enable individuals to exercise control over their learning.

The first two objectives concern the theoretical framework for this paper, and for the most part, have been addressed in earlier sections of this paper. However, it may now be beneficial to restate briefly the manner in which adjunct questions relate to the information-processing theory of learning, the umbrella model used in this paper. The reader may wish to refer to Figure 1 which presents a diagram of the flow of the information-processing model.

Information-Processing Model/Adjunct Questions: How They Relate

Arousal is produced within the learner as a result of the adjunct question, which serves as a stimulus change. Executive control processes within the learner are influenced by the test-like items with respect to choosing strategies which determine what the learner will selectively perceive and attend to when reading the passage. Further, prequestions serve to activate an expectancy set, and suggest categories or associated networks under which the information might be subsumed. Postquestions, used at this point, might suggest organizational categories for the subsequent passage.

The adjunct questions provide suggestions for encoding strategies which enable efficient processing while in the short term memory (working memory). Here, the level of the questions plays a major role. High level questions transform the information in such a manner as to require deep processing which activates retrieval of associated material from the long term memory, thus establishing a variety of relationships between new and already existing knowledge within the learner. Consequently, when this associated

information is processed with the new information in the short term memory, additional encoding takes place before it returns to the long term memory where semantic storage of old and new propositions transpires. As a result, the amount of retrieval cues is increased which enhances the possibilities of future retrieval for the criterion measure.

Serving as an expectancy set for retrieval, the adjunct questions act as vehicles which support the encoding specificity principle (Klatzky, 1975); that is, chances are greater for future search and successful retrieval if similar cues are employed on the criterion measure in relation to those used for the original encoding. The categories suggested by the adjunct questions enable the learner to retrieve not only intentional information, but also, additional information from nearby categories stored in the long term memory (incidental information not addressed via the adjunct questions). Higher level questions enable additional processing or transformations to take place, which actively retrieve associated information from the long term memory.

Post adjunct questions at this point serve as reviews and strengthen or generate new retrieval cues within the learner. This practice in retrieval strengthens the possibility for future search and retrieval on the criterion measure which can, in fact, return the semantically encoded materials directly from the long term memory to the response generators and, in turn, the effectors.

Feedback, both internal and external to the learner, informs him/her of incorrect answers, in which case, he/she may revise processing strategies; or, in the case of correct responses, this feedback serves as reinforcement, and a signal to continue with the same type of successful processing strategy being currently employed.

In transfer situations, which are the true tests of learning, opportunities are presented in which the learner may apply the newly learned strategy to novel situations to assess whether the strategy has, in fact, been learned.

Gagné (1977) provides a summarizing conclusion in regard to these strategies when he states that it has been difficult to show that deliberate attempts to teach cognitive strategies (executive control processes) result in consistent and substantial learning and transfer (p. 176). He recommends future studies that test for transfer of these strategies which might be more convincing that this new internal state has been acquired.

Exercising Control over One's Learning

As indicated in objective three, data which support or do not support the use of adjunct questions to facilitate individuals' development of strategies which enable them to manage their own learning were sought. However, as previously indicated, this task is not easy; that is, the studies analyzed failed to provide any substantial or consistent support that as a result of using adjunct questions a learner may develop strategies which enable him/her to control his/her own learning.

Although some researchers might be inclined to infer that an increase in the amount of learning as a result of using adjunct questions suggests adoption of specialized processing strategies, this cannot be assumed from one experiment. Ideally, a series of experiments in which transfer is required might begin to substantiate acquisition of newly formed strategies applied to novel situations. However, no conlusions can be formed when considering the data available within this paper.

Analysis of Empirical Evidence

The previous section of this paper provides a critical analysis of the twenty studies with regard for age and ability of the learners, and level of questions, and the results are integrated among these segments, as indicated by the variables, thus satisfying objective four.

Weaknesses and Limitations of the Studies

Objective five proposes that pitfalls which appear in the studies are indicated. The weaknesses and limitations are discussed in the analysis section of the paper, and are summarized as follows:

1. Lack of reported validity /reliability of instruments and treatment materials.
2. Treating a nonsignificant difference finding as if it were significant, and proceeding to report the success of the treatment.
3. Possible presence of artifacts such as those resulting from the use of volunteer participants, experimenter

expectancy, evaluation apprehension, and demand characteristics.

4. No assessment of prior experience with the learning materials and content.
5. Absence of formative evaluation (pilot studies) prior to the conduct of the experiment.
6. Lack of theoretical framework.
7. Uncontrolled study time.
8. Absence of operational definitions.
9. Lack of longitudinal studies (most treatments are brief).
10. Failure to inform participants of purposes of the experiment.
11. Absence of debriefing interviews to determine what types of strategies were actually employed.
12. Inappropriate statistical procedures.
13. Prompting the participants with administrative directions which suggest learning of all general material, not only incidental, thus biasing the study.
14. Interchanging verbal information questions with intellectual skill questions without considering conditions of learning prior to comparison of outcomes.
15. Absence of attitude measures to determine effect adjunct questions have on participants.
16. Inappropriate difficulty levels of treatment materials for target population.
17. Failure to report possible threats to validity, such as unusually high mortality due to drop outs.
18. Absence of control groups.
19. Failure to provide feedback to the learner which resulted in high frustration levels.
20. Lack of studies involving younger learners.

Additional limitations of the studies are reported within the critical analysis section of this paper.

Objectives six, seven, and eight are discussed previously, and are included in Tables 1, 2, and 3, which enable the reader to compare and contrast results from the studies, as well as provide information regarding each variable addressed (age and ability of the learner, and level of questions).

Recommendations for Future Research

Objective nine proposes the areas in which additional research might be focused be recommended.

Theoretical recommendations. Since a major thrust of this paper is the theoretical aspect, it would follow that areas of future research might continue in this realm. For example, a dual processing theory of long term memory structures might be investigated in which encoding may take place in verbal propositions and in images. Further, additional types of memory structures may be present which, in turn, could be influenced by different types of stimuli.

Learning outcomes and delivery modes. It is observed that the studies selected for analysis possess two major characteristics: they are mainly comprised of verbal information (factual) materials, in a printed format. Expanding upon the suggestion to pursue different types of memory structures, the use of nonprint (multi-media)

delivery systems, both remote and local, such as those proposed by Ackerman (1977) and Dayton (1977), should be investigated. Further, different types of learning outcomes should be examined. Both verbal information and intellectual skills should be addressed. Caution should be taken when conducting studies involving intellectual skills. Specifically, the design of the treatment materials must be systematic, as exemplified by Briggs et al (1977). By adhering to principles of instructional design, some of the glaring pitfalls encountered in many of the studies might have been avoided. For example, conducting formative evaluation on treatment materials enables the researcher to ascertain whether the materials are, in fact, effective and appropriate for the target population.

Aptitude-treatment interactions. Research in the area of aptitude-treatment interaction, with special attention toward different types of processing strategies interacting with aptitudes of the learners, appears to be a promising focal point. Perhaps instructional materials may be prescribed in accordance with cognitive styles and other attributes of the learners. Additional cueing devices such as typographical techniques (underlining, color coding) might be considered in conjunction with adjunct questions.

Transfer tasks. Further concentration on the acquisition of processing strategies might be substantiated by administering transfer tasks to the learners. It is desirable that future studies in this area are designed to encompass a long term effect, rather than the typical

brief treatments that have frequently constituted the majority of the studies. In addition, delayed retention tests might make contributions within the area of adjunct questions.

Participants. Several recommendations may be offered concerning the characteristics of the participants. Future studies should include younger learners of average, low, or high ability levels. Again, the instruments and ranges used to classify the ability levels must be clearly indicated. Further, the variable of socio-economic status has subtly entered many studies, but has not been treated with proper attention. Finally, the use of volunteers permits room for presence of artifacts which may have biased some of the results reported in another section of this paper. If volunteers must be used, the experimenter should carefully investigate the characteristics of the nonvolunteers in the same population, since it has been demonstrated that volunteers possess unusual traits, such as above average intelligence, need for approval, and more sociable (Rosenthal & Rosnow, 1969).

Attitude. None of the studies examined reported the administration of any type of attitudinal questionnaire, which might provide data for designers of instruction with respect to preferences held by the learners concerning the use of adjunct questions.

Debriefing. Another post experimental procedure which was not often found in the studies was a debriefing session in which the learners were provided with details concerning the experiment, and were questioned in regard to the strategy employed for inspection of the materials. However, Salatas

and Flavell (1976) did conclude, when conducting a study of a comparable nature, that kindergartners and third graders were unable to verbalize any details with respect to the type of strategy they adopted for processing of the information. Perhaps some type of instrument or observation procedure might be designed which could indicate the strategy used by the participant.

Administrative directions. When discussing types of strategies, the question of how much influence the administrative directions may have on the performance during the experiment is raised. For example, a study which supposedly emphasized incidental learning (unrelated to the adjunct questions) was conducted in such a manner that provided the participants with instructions to complete the materials, and be prepared for a general test which consisted of questions similar to those in the treatment questions at the end of the experiment. Concern may be raised as to whether this type of administrative direction served as a stimulus for the PAID VOLUNTEERS to engage in a reading strategy which established an expectancy for the material related to the adjunct questions, as well as an expectancy for the information that was not related (incidental). In other words, the instructions translated into simpler terms might have been interpreted to mean, "learn all you can for a test on everything in the passage." Future studies should investigate what influence this type of direction has on the performance of the learner.

Feedback. Another variable which may affect the type of processing strategies which should be used is the kind of

feedback provided which informs the learner of his accuracy when responding to the questions. How does this feedback (when provided) cause the learner to modify his inspection strategy when reading the materials? Does absence of informative feedback result in learner frustration? Or perhaps the necessity of feedback is contingent upon the level of the question, or the ability of the student? By examination of Table 1, it can be determined which of the studies were designed to provide feedback, and the subsequent results.

Control of study time. Future studies should provide equal amounts of inspection (study) time to experimental and control groups. In an experiment conducted by Rothkopf and Bisbicos (1967), (see Table 1) study time varied, and consequently, the adjunct question group which excelled in performance also consumed a greater amount of time than the control group. Carver (1972) criticizes Rothkopf for the lack of study time control, and suggests that merely telling the students to study hard and long, while granting additional amounts of time, might be more efficient than using adjunct questions. In a subsequent article, Rothkopf (1974) states that "inspection time per page does not correlate well with learning gains per page." (p.4) Further, Rothkopf raises the question, "Who would despise a treatment that caused a student to study more effectively, even if it did take more time?" An example might be preparing for preliminary examinations for doctoral degrees. (Table 1 indicates which studies reported controlled study time.) Thus, future research might investigate experiments in which study time is controlled, and which employs a group which is

provided with explicit directions for recommended strategies, but without adjunct questions.

Definition of terms. Confusion may have evolved as a result of inconsistent definitions of terms. Future studies should clarify terms with specific emphasis on variables and conditions.

Replication. It appears that the results of several of the studies may have been influenced by the presence of artifacts. Therefore, it is recommended that replicated studies, properly designed to confirm or reject the presence of these possible biases, be conducted.

Meta-analysis. Gene Glass explains a statistical technique in the November, 1976, issue of Educational Researcher, by which large collections of analysis results from individual studies can be integrated. Applying his techniques to the effect sizes from various adjunct question studies may, in fact, serve as a means to derive new relationships among the variables, which appears to be a direction worthy of future investigation.

Reexamination of the objectives for this paper shows that each objective was, in fact, thoroughly addressed; however, in many cases, definitive conclusions cannot be drawn from the data at hand.

The culminating section of this paper provides the reader with additional recommendations emanating from the review, and capsulizes its contents.

Additional Recommendations and Summary

This paper presents integrated results of theoretical and empirical research in the area of adjunct questions in prose materials, in addition to suggesting pragmatic and future implications, that are interwoven throughout the review.

A brief fifty year historical compendium presents previous research which fostered the contemporary interest in adjunct questions, and serves as an advance organizer for the subsequent sections of the paper. The phenomenon of mathemagenic behavior is introduced with reference to types of activities that might facilitate the occurrence of these inspection strategies. Results of empirical studies are interspersed throughout the paper in order to support the observations made by this author.

Next, the problem is identified with special reference to the three variables addressed in this review: age and ability of the learner, and level of questions.

In essence, a major question serves as the focal point of this paper: for what particular age and ability groups can adjunct questions influence the development of strategies which enable an individual to exercise control over his/her own learning, and consequently, facilitate the amount of learning that transpires when reading a prose passage?

The scope of this review of twenty experimental studies embraces a period of the last thirteen years. Additional references are cited throughout the paper in order to document theoretical constructs and related empirical research in the

area of adjunct questions.

Further, a general theoretical framework is provided, as well as a specific theoretical framework for each of the above three variables.

Special attention is given to an information-processing model for learning which is proposed as a theoretical umbrella under which the hypothesized constructs regarding adjunct questions may be incorporated. Some of the major functions of adjunct questions might be as follows: stimulating arousal within the learner, influencing executive control processes by directing attention and selective perception, establishing expectancies, suggesting encoding strategies which facilitate retrieval, and providing opportunities for review via practice retrievals prior to the criterion measure. In the case of correct responses, feedback serves as confirmation; whereas, incorrect responses signal that revision of the adopted strategy is necessary during the remaining portions of the passage.

Although the results of the studies are by no means consistent, this author concludes that low ability students using these test-like items benefit more than high ability students. Higher order questions enhance greater amounts and deeper learning than do lower order questions due to transforming and encoding large amounts of new material with the previously acquired information.

The studies appear to support the use of adjunct questions to facilitate <u>intentional</u> learning, but do not provide consistent data that indicate <u>incidental</u> learning can be enhanced by using adjunct questions.

Some researchers have hypothesized that children process information differently than adults, and hence might not benefit from adjunct questions. However, one overriding aspect of these studies is the outcome of a series of experiments in which children, when taught cue retrieval strategies, did not use them spontaneously (Salatas & Flavell, 1976), and therefore, it is imperative that young learners be reminded of previously mastered strategies prior to reading instructional materials. In fact, this reminder may be advisable for older learners, as well as children. It is recommended that when using verbal information materials, meaningful contexts which enable learners to retrieve associated information when responding to adjunct questions, thus increasing the amount of intentional and incidental learning, are employed (Gagné, 1977).

In the case of higher order questions, recall of prior learning should be stimulated in order to facilitate transformation of the new information via an integration with previously learned information.

Retrieval cues on the criterion measure should be congruent with those used in the original encoding and storage, which is in accordance with the encoding specificity principle (Klatzky, 1975). The review process via these test-like items enhances encoding and storage.

Limitations of previous research and areas for future research have been illuminated. The success of future research in the area of adjunct questions must be insured by the inclusion of clearly defined terms, carefully validated instruments, better control of variables, and improved method-

ological procedures. (Criteria for the conduct of experimental research are presented in Appendix B.)

With the data from these studies at hand, this reviewer is unable to offer any substantial conclusions as to whether the employment of adjunct questions facilitates the acquisition of strategies within an individual, that promote self-management of learning. However, opportunities for transfer of the presumably acquired strategies within the learner to novel situations might assist future researchers to ascertain the existence of the strategies, to help them avoid making inferences concerning increases in the amount of learning.

Not wishing to leave the reader held in total abeyance, this writer ventures to presently conclude by recommending the following:

1. Employ the use of post adjunct questions for learning intentional information, especially for low ability students.
2. Use higher order questions to promote deeper processing, greater learning, and retention.
3. Stimulate recall of processing strategies or suggest adoption of new ones prior to completing the instructional materials (especially for young learners).
4. Conduct additional theoretical and empirical research as suggested in a previous section of this paper , with special attention toward different learning outcomes and memory structures, transfer tasks, aptitude-treatment interactions, and other modes of instruction, such as nonprint media.

The following suggestions are offered for the design of

instruction: do not assume that the inclusion of adjunct questions enhances the acquisition of unrelated (incidental) information; however, these test-like items may be employed for an anticipated increase of intentional information, which is directly related to the content of the adjunct questions. Further, in cases where "off the shelf" materials which have not been systematically designed, must be used, these test-like items may compensate for the lack of desired conditions of learning.

It remains to be determined, however, whether in some cases involving incidental learning, if the time and money invested might be just as effectively used by providing learners additional study time and explicit directions suggesting an inspection strategy (Carver, 1972; Ladas, 1973). Again, indeed, there are many QUESTIONS that remain to be explored in the research area of adjunct questions.

References

Ackerman, A.S. Chapter 16 in L.J. Briggs (Ed.). Instructional design: Principles and applications. Englewood Cliffs, N.J.: Educational Technology Co., 1977.

Allen, D.I. Some effects of advance organizers and level of question on the learning and retention of writted social studies material. Journal of Educational Psychology, 1970, 61 (5), 333-339.

Anderson, R.C. Control of student mediating processes during verbal learning and instruction. Review of Educational Research, 1970, 40, 349-369.

Anderson, R.C. & Biddle, W.B. On asking people questions about what they are reading. in G. Bower (Ed.). Psychology of learning and motivation, vol. 9, New York: Academic Press, 1975.

Atkinson, R.C. & Shiffrin, R.M. The control of short-term memory. Scientific Memory, 1971, 225 (2), 82-90.

Ausubel, D.P. The psychology of meaningful verbal learning. New York: Grune & Stratton, 1963.

Barry, R.J. The concept of mathemagenic behaviour: An analysis of its heuristic value. Perceptual and Motor Skills, 1974, 38, 311-321.

Boyd, W.M. Repeating questions in prose learning. Journal of Educational Psychology, 1973, 64 (1), 31-38.

Briggs, L.J. The development and appraisal of special procedures for superior students and an analysis of the effects of "knowledge of results," Abstracts of Doctoral Dissertations. No 58, The Ohio State University Press, 1949.

Briggs, L.J. Review of research in adjunct autoinstruction, Dymedia Technical Report, No. 1, Palo Alto, California, Dymedia, Inc. Dec. 1967.

Briggs, L.J. (Ed.) Instructional design: Principles and applications. Englewood Cliffs, N.J.: Educational Technology, Inc. 1977.

Brown, A.L. Mnemonic elaboration and recency judgments in children. Cognitive Psychology, 1973, 5, 233-248.

Carmichael, L. & Dearborn, W.F. Reading and visual fatigue. Boston: Houghton Mifflin, 1947.

Carroll, J.B. Learning from verbal discourse in educational media: A review of the literature (Research Bulletin RB-71-61) Princeton, N.J.: Educational Testing Service, Oct. 1971.

Carson, R.I. The sea around us (rev. ed.) New York: Oxford Press, 1961.

Carver, R.P. A critical review of mathemagenic behaviours and the effect of questions on the retention of prose materials. Journal of Reading Behavior, 1972, 4 (2), 93-118.

Collins, A.M. & Lofts, E.F. A spreading activation theory of semantic processing. Psychology Review, 1975, 82 (6), 407-428.

Dayton, Deane K. Inserted post-questions and learning from slide/tape presentations: Implications of the mathemagenic hypothesis. Audiovisual Communication Review, 1967, 25 (2), 125-146.

Faw, H.W. & Waller, T.G. Mathemagenic behaviours and efficiency in learning from prose materials: Review, critique, and recommendations. Review of Educational Research, 1976, 46 (4), 691-719.

Felker, D.B. & Dapra, R.A. Effects of question type and question placement on problem solving ability from prose material. Journal of Educational Psychology, 1975, 67 (3) 380-384.

Frase, L.T. Questions as aids to reading: Some research and theory. Association of Educational Research Journal, 1968, 5, 319-332.

Frase. L.T. Cybernetic control of memory while reading connected discourse. Journal of Educational Psychology, 1969, 60, 49-55.

Frase, L.T. Boundary conditions for mathemagenic behaviors. Review of Educational Research, 1970, 40, 337-347.

Frase, L.T. Sampling and response requirements of adjunct questions. Journal of Educational Psychology, 1973, 65 (2) 273-278.

Furman, J.P. The effects of post adjunct questioning on learning from written and oral instruction: Interactions with individual differences. Unpublished doctoral dissertation, The Florida State University, 1974.

Gagné, R.M. The conditions of learning (2nd ed). New York: Holt, Rinehart, & Winston, 1970.

Gagné, R.M. Domains of learning. Interchange, 1972, 3, 1-8.

Gagné, R.M. Learning and instructional sequence. In F.N. Kerlinger (Ed.), Review of Research in Education, Itasca,Illinois: Peacock Publishers and American Educational Research Association, 1973.

Gagné, R.M. Essentials of learning for instruction. New York: Dryden Press, 1974.

Gagné, R.M. The conditions of learning (3rd ed). New York: Holt, Rinehart, and Winston, 1977.

Gagné, R.M. & Wiegard, V.K. Effects of a superordinate context on learning and retention of facts. Journal of Educational Psychology, 1970, 61 (5), 406-409.

Gates, A.I. Recitation as a factor in memorizing. Archives of Psychology, 1917, 6, 1-104.

Halstead, J.B. Reading comprehension requirements for different instructional objectives: The effects of post adjunct questions and orienting directions. Unpublished doctoral dissertation, The Florida State University, 1975.

Hershberger, W. Self-evaluational responding and typographical cueing: Techniques for programing self-instructional reading materials. Journal of Educational Psychology, 1964, 55 (5) 288-296.

Hesse, K.D. & Smith, R.J. The effect of content and process questions written at memory and evaluation levels on ninth grade students' comprehension of a passage when the questions have been inserted either before or after segments of the passage. Paper presented at Annual Convention of the International Reading Association, New Orleans, May, 1974. (ERIC Document ED 095510).

Hiller, J.H. Learning from prose text: Effects of readability level, inserted question difficulty, and individual difference. Journal of Educational Psychology, 1974, 66, 189-201.

Hoffman, A.C. Eye-movements during prolonged reading. Journal of Experimental Psychology, 1946, 36, 95-118.

Jones, H.E. The effects of examination on performance of learning. Archives of Psychology, 1923-1924, 10, 1-70.

Kerlinger, F.N. Foundations of behavioral research (2nd ed). New York: Holt, Rinehart, & Winston, Inc., 1964.

Klatzky, RL.L Human memory. SanFrancisco: Freeman & Co. 1975.

Koran, M.L. & Koran, J.J. Interaction of learner aptitudes with question pacing in learning from prose. Journal of Educational Psychology, 1975, 67 (1) 76-82.

Kroll, H.M. The relative effectiveness of written and individualized audio instruction in the intermediate grades. Audiovisual Communication Review, 1974, 22 (3), 247-268.

Ladas, H. The mathemagenic effects of factual review questions on the learning of incidental information: A critical review. Review of Educational Research, 1973, 43 (1), 71-83.

Lucking, R.A. A study of the effects of a hierarchically ordered questioning technique on adolescents' responses to short stories. Unpublished Doctoral Dissertation, University of Nebraska-Lincoln, 1975. (ERIC Document ED 119194.

Mayer, R.E. Forward transfer of different reading strategies evoked by test-like events in mathematics texts. Journal of Educational Psychology, 1975, 67, (2), 165-169.

McGaw, B. & Grotelueschen. Direction of the effect of questions in prose material. Journal of Educational Psychology, 1972, 63 (6), 580-588.

Popham, W.J. Educational evaluation. Englewood Cliffs, N.J.: Prentice-Hall, 1975.

Postman, L. Burns, S. & Hasher, L. Studies of learning to learn; X. Nonspecific transfer effects in free-recall learning. Journal of Verbal Learning and Verbal Behavior, 1970, 9, 707-715.

Pressey, S.L. A simple apparatus which gives tests and scores--and teachers. School and Society, 1926, 23 , (586), 373-376.

Pressey, S.L. Development and appraisal of devices providing immediate automatic scoring of objective tests and concomitant self-instruction, Journal of Psychology, 1950, 29, 417-447.

Quillian, M.R. Word concepts: A theory and simulation of some basic semantic capabilities. Behavioral Science, 1967, 12, 410-430.

Rickards, J.P. Interaction of position and conceptual level of adjunct questions on immediate and delayed retention of text. Journal of Educational Psychology. 68 (2), 210-217.

Rickards, J.P. On inserting questions before or after segments of text. Contemporary Educational Psychology, 1977, 2 (2), 200-206.

Rickards, J.P. , Anderson, M.C. & McCormick, C.B. Processing effects of commonword and number questions inserted in reading material. Journal of Educational Research, 1976, 69, 274-277.

Rickards, J.P. & DiVesta, F.J. Type and frequency of questions in processing textual material. Journal of Educational Psychology, 1974, 66 (3), 354-362.

Rosenthal, R. & Rosnow, R.L. Artifact in behavioral research. New York: Academic Press, 1969.

Rothkopf, E.Z. Learning from written instructive material: An exploration of the control of inspectation behavior by test-like events. Association of Educational Research Journal, 1966, 3, 241-249.

Rothkopf, E.Z. The concept of mathemagenic activities. Review of Educational Research, 1970, 40 (3), 325-336.

Rothkopf, E.Z. Variable adjunct question schedules, interpersonal interaction, and incidental learning from written material. Journal of Educational Psychology, 1972, 63 (2), 87-92.

Rothkopf, E.Z. Barbarism and mathemagenic activities: Comments on criticism by Carver. Journal of Reading Behavior, 1974, 6 (1), 3-8.

Rothkopf, E.Z. & Billington, M.J. Indirect review and priming through questions. Journal of Educational Psychology, 1974, 66 (5), 669-679.

Rothkopf, E.Z. & Bisbicos, E.E. Selective facilitative effects of interspersed questions on learning from written materials. Journal of Educational Psychology, 1967, 58 (1), 56-61.

Rothkopf, E.Z. & Kaplan, R. Exploration of the effects of density and specificity of instructional objectives on learning from text. Journal of Educational Psychology, 1972, 63, 295-302.

Salatas, H. & Flavell, J.H. Retrieval of recently learned information: Development of strategies and control skills. Child Development, 1976, 47, 941-948.

Salomon, G. Heuristic models for the generation of ATI hypotheses. Review of Educational Research, 1972, 42, (3), 327-343.

Sanders, J.R. Retention effects of adjunct questions in written and aural discourse. Journal of Educational Psychology, 1973, 65 (2), 181-186.

Shavelson, R.J. & Berliner, D. Effects of position and type of question on learning from prose material: Interaction of treatments with individual differences. Journal of Educational Psychology, 1974, 66 (1), 40-48.

Swenson, I. & Kulhavy, R.W. Adjunct questions and the comprehension of prose by children. Journal of Educational Psychology, 1974, 66 (2), 212-215.

Wadsworth, B. & Flagg, B. The effect of interspersed questions on learning from written materials in elementary school children and college students. Paper presented at American Educational Research Association. New York, 1971. (ERIC Document ED 048094).

Wagner, B.M. Mathemagenic effects of post adjunct questions in three response modes on the learning of factual knowledge and its application. Unpublished doctoral dissertation, The Florida State University, 1976.

Walker, B.S. Effects of inserted questions on retroactive inhibition in meaningful verbal learning. Journal of Educational Psychology, 1974, 66 (4), 486-490.

Washburne, J.N. The use of questions in social science material. Journal of Educational Psychology, 1929, 20, 321-359.

Watts, G.H. & Anderson, R.C. Effects of three types of inserted questions on learning from prose. Journal of Educational Psychology, 1971, 62 (5), 387-394.

Wittrock, M.C. & Lumsdaine, A.A. in Annual Review of Psychology, M.R. Rosenzweig & L.W. Porter (Eds.), 1977, Vol. 28, Palo Alto, California: Annual Reviews, Inc.

Yost, M. The effect on learning of post instructional verbal responses to questions of different degrees of complexity. Final Report, Office of Education, WDC. (ERIC Document ED 045391).

Appendix A

Criteria for the Evaluation of Published Research

Amy S. Ackerman

Amy S. Ackerman
IDD 655
June 28, 1977

Project I - Criteria for the Evaluation of Published Research

I. Statement of the Problem

A. The problem states how the study will perform one of the following:
   1. Presents new data that shed light on previously unexpected phenomena.
   2. Reorganizes old data to show relationships not detected previously.
   3. Reinforces tentative findings of other researchers that require verification.

B. The problem is interesting and focuses attention on more than merely a local level.
C. Theoretical framework is present within the problem.
D. The problem is unique and contains some originality in either purpose or method.
E. A relationship is expressed between two or more variables.
F. The problem is clearly stated in question format, early in the study.
G. Implications for empirical testing are clearly indicated.
H. The problem is of manageable size and does not contain an excessive amount of elements addressed simultaneously.
I. The problem is practical and economical.
J. The study is warranted now rather than being too premature, in which case it would be more practical to conduct a pilot study.
K. Description of the problem leaves a clear intent rather than a nebulous one.
L. Assumptions are specified.
   1. They are shown to be valid by either previous research or proving many authorities accept them.
   2. The assumptions are linked to theoretical framework within which the researcher intends to work and are presented in a logical and inclusive chain of reasoning.

II. Review of the Literature

A. The review is well organized to show relationships of various studies to each other and form the initial groundwork for the development of theory.
B. The topic is adequately related to previously completed studies.
C. It is selective rather than exhaustive.
D. If similar and equally valuable articles appear on the same subject, the most recent were chosen.
E. An indication is made as to the reason why each reference was selected.

F. In cases of conflicting findings, both cases are presented.
G. Different points of methodology and techniques are included.
H. All variables under investigation are included in the review.
I. The studies are synthesized into a network of relationships, which prepare for the logical leap into the hypothesis construction rather than merely listing a chronological representation of previous research.

III. Hypotheses

A. The hypotheses are written in the form of statements, not questions, and the terms are clearly defined in operational terms.
B. Implications can be empirically tested.
C. Relationships are explained between two or more variables.
D. The hypotheses are consistent with other known facts.
E. The writing style is such that another researcher could replicate the experiment after reading the description.
F. Prediction of facts and relations that were previously unknown will be enhanced as a result of the hypothesis testing.
G. When appropriate, multiple hypotheses are proposed, rather than one preferred hypothesis in order to avoid "Investigator Paradigm Effect."
H. Alternate rival hypotheses are mentioned and taken into consideration.
I. The hypotheses are novel, and have not been previously studied.
J. The research hypothesis is properly worded, not in the null form.

IV. Definition of Terms

A. The important variables and terms are clearly defined.
B. The more important concepts are defined in operational terms.
C. The terms are consistently defined and used.
D. Unnecessary technical jargon is avoided.
E. Definitions are non-circular.

V. Sampling

A. The involved population is precisely described.
B. The sample is drawn from the described population.
C. The sample is of sufficient size (in all cells), in order to obtain the desired power of the study.
D. The method of drawing the sample is clearly indicated.
   1. Randomization is used for selection of participants and assignment to groups.
   2. Treatments are assigned to groups in a random manner.
E. Both groups (experimental and control) are drawn from the same population.
F. An external source did not determine the sample, which may have resulted in a bias effect.
G. A plan is included to determine the equivalence of groups.
H. The participants are clearly described in regard to how they were obtained (volunteers, non-volunteers, paid, etc...)
I. The generalization factor is clearly identified concerning the limitations of the study.
J. The problem could not be simplified by limiting the sample to a more narrow age range, grade range, or geographic range.

VI. Ethics

A. The participants were informed of all features of the research that might influence willingness to participate, and disclosed of all information regarding the experiment which they desired.
B. No deception was involved.
C. The participants could refuse to take part in the experiment, or drop out at any time.
D. Proper consent was sought prior to participation.
E. The responsibilities of the participants were clearly indicated.
F. At no time were the participants exposed to mental or physical discomfort or harm, stress, or danger.
G. After data collection, the participants were informed as to the nature and results of the study during a complete debriefing.
H. Information obtained is kept confidential.

VII. Research Design

A. The design is appropriate to the problem, and will test the hypotheses.
B. The overall design has been carefully considered.
C. Scientific imagination is included in the design.
D. Data can be collected to investigate the problem.
   1. Necessary tools are available.
   2. Participants are available.
   3. The researcher possesses the necessary skills to obtain the data.
D. There is a relation between the data to be collected and the hypotheses which the study is attempting to test.
E. Detailed observations of individual participants are available to supplement mass data.
F. The description of the approach is clearly presented.
G. "Response sets" have been considered and prevented.
H. The results are not influenced by the order or position of the materials.
I. All experimental hypotheses are included in the design.
J. All intervening variables are accounted for in the design, as well as the other variables.
K. The design permits randomization of variables which are not desired to influence the results.
L. Error variance is minimized; controls are adequate.
M. The null hypotheses are rigorously defined and related to the problem.
N. The level of significance necessary for rejection is specified prior to collection and analysis of data.
O. The treatment time is sufficient to take effect.
P. A control group is present.
Q. Assumptions underlying the use of statistical techniques have not been violated.
R. Threats to internal validity are controlled.
   1. History- effects due to passage of time.
   2. Maturation- effects due to normal growth of participant.
   3. Testing- anxiety due to emotional state and sensitizing due to pretesting which increases posttest scores.
   4. Instrumentation- change in test instruments rather than participant.
   5. Statistical regression- extreme scores tend to approach the mean when not perfectly correlated.
   6. Selection- methods in which participants were obtained.
   7. Mortality- drop-outs and types may make groups unequal.

S. Threats to external validity are controlled.
1. Interaction effect of testing-- pretest may alter participant's response to the experimental variable.
2. Interaction of the experimental variable and the selection process--- participants may respond to the combined effects of the experimental variable and the differences which reflect the manner in which they were secured, rather than the experimental variable alone.
3. Reactive effects of experimental arrangements-- the results of the study may not generalize beyond the experimental setting if it was the unique characteristic of the setting itself which facilitated any effect. (An example would be Hawthorne effect.)
4. Multiple treatment effect-- one or more previous treatments may influence results of present experiment.

VIII. Materials
A. Quality and quantity have been considered.
B. Formative evaluation has been conducted on materials to be used for treatments.
C. Materials have been approved by a subject matter expert.
D. Materials are objective-referenced.
E. Content is current; equipment is contemporary.
F. Copyright was not infringed as a result of using the materials; footnotes are given where appropriate.

IX. Tests and Measures
A. The investigator has the expertise with required measures, scales, tests, and instruments, in order to conduct the experiment.
B. A sufficient number of test items is present.
C. Judges have adequate backgrounds for rating.
D. Appropriate measures are used.
E. Measures are independent.
F. The difficulty level of the test is considered.
G. Available norms are indicated with which the results might be compared.
H. The total point score is not a sum of different factors, which would be like adding apples and peaches together.
I. High and low scorers are separated by a discrimination index.
J. If the instrument is newly developed, appropriate steps have been taken to validate them.
K. Appropriate forms of reliability are sought.
1. Parallel forms--slightly different tests should result in comparable scores.
2. Test/retest- same test used as pre and post test with time lapse inbetween administration in which treatment may be administered to experimental group.
3. Internal consistency-- participants perform comparable on each half of a test.
L. In relation to previous research, the reliability coefficient is acceptable in order to credit the study.
M. The appropriate form of validity is indicated.
1. Predictive= used to estimate future behavior.
2. Concurrent- estimates present behavior.
3. Content validity- represents the adequacy with which a specified content domain is sampled
4. Construct validity- estimates the amount of a hypothesized variable.
N. The validity coefficient is acceptable in relation to past studies.

X. Procedure
- A. Technique is suitable.
- B. An orderly and systemtaic arrangement is provided.
- C. Any proctors present are unbiased.
- D. An appropriate location is chosen, either lab or field-based.
- E. The "Investigator Loose Procedure" effect has been avoided by planning detailed steps for implementation of the study.
- F. The experimental protocol was followed by the researcher.
- G. Any revisions in the procedure were justified and noted.

XI. Data Collection and Presentation
- A. The researcher determined the procedure for data collection and analysis early in his investigation.
- B. The classified categories are sufficient, and no unnecessary data were collected.
- C. An observer or scorer bias did not take place due to access to information about previous behavior of participants.
- D. Collection source errors were checked such as record keeping, computations, copying quotations...).
- E. Graphics representing data are professional and easy to read.
- F. Responses were recorded in a systematic manner, not randomly.
- G. Footnotes were included where appropriate.

XII. Analysis of Data
- A. Appropriate statistical techniques were selected.
- B. Analyses procedures concur with frame of reference presented in the problem.
- C. Opinion and personal prejudice are not present.
- D. All evidence is included, even if it does not support hypotheses.
- E. Any unpredicted relationships are presented, as well as those anticipated.
- F. Uncontrolled factors are illuminated that may have affected the results.
- G. Any weakness in the data is honestly admitted.
- H. All statistical procedures are properly administered.
- I. The level of significance is adequate.
- J. The level of confidence and standard error of measurement are reported.
- K. The analysis reflects the relationship between the following:
  1. Alpha level- probability of Type I error (rejecting the null hypothesis when it is true).
  2. Beta rate- probability of Type II error (failure to reject the null hypothesis when it is not true).
  3. Power--probability of rejecting the null hypothesis when it is false. Power= 1- Beta.
  4. Effect size- the size of difference which the experimenter wishes to detect with the probability of power.
  5. Sample size- function of alpha level, effect size, and power the statistical test employed.
- L. If data fail to support the original hypothesis, does the researcher report it or derive new hypotheses (a "no-no").
- M. Did researcher collect incidental data for back-up if original data findings did not yield significanct results- also a "no-no."
- N. Additional data analysis effects which are common pitfalls:
  1. Post-mortem analysis of data to yield a significant result.

2. Multiple tests of significance may lead to erroneous conclusions (with two independent analyses, the probability of "significant findings" is greater than 5% level--pyramiding effect.
3. Do negative results appear in the report if, in fact, they were obtained?
4. If positive results were obtained, were the previous negative results in earlier reports also reported?
5. When a positive result is obtained, does researcher check his computations, not only with negative results?
6. When statistical significance is reached, is the degree of strength between two variables when small or negligible, also pointed out?
7. Were data fudged?
8. Were attributes of the experimenter taken into account in regard to participant responses (sex, race, age, friendliness, physical features....).

XIII. Summary and Conclusions

A. Are results concisely and precisely stated?
B. Do data verify results?
C. Are limitations of study indicated and future possibilities recommended?
D. Does the summary recapitulate the study or mistakenly introduce new data?
E. Is a statement regarding rejection or non rejection of hypothesis included?
F. Are questions which arose during the study indicated for investigation?

XIV. Reporting

A. Style is appropriate.
   1. The report is neat, attractive, and well divided into sections in an organized manner.
   2. No padding is present.
   3. The active voice is used whenever possible.
   4. The jargon is appropriate.
   5. The style is consistent with correct grammar, punctuation, spelling.
   6. "Law of parsimony" is followed.
   7. Graphics are professional and accurate.
   8. The tone is unbiased.
   9. The report is not overly condensed which would require elaboration or supplementary documentation.

B. The findings are not generalized beyond the population from which the sample was drawn.
C. An attempt is made to bridge the gap between theory and practice.
D. Funding did not influence the report.
E. The report is such that others could replicate the experiment.
F. The report describes how, when, and where the data were collected.
G. Limitations of the study are indicated.

H. Significances are clearly distinguished (statistical and practical).
I. Additional contents beyond experimental steps:
   1. Abstract
   2. Index (when appropriate)
   3. Bibliography
J. The report communicates well with the non specialist, as well as the specialist.
K. Copies of oral and written directions to the participants are included within the report, as well as any questionnaires and printed forms used in the investigation.
L. If no relation appeared to be present between X and Y, were the following points considered:
   1. X, Y, are completely unrelated.
   2. There is a hidden relation.
   3. There was an inflated error term.
   4. The true difference was suppressed due to invalidity or ceiling effect.
   5. There was an insufficient difference in X.
      a. The treatment was too short.
      b. Measurement error appeared.
      c. Differences in treatments were too slight.
   6. There were compensating interactions. (X may have two types of effects that nullify each other and thus, a non-significant difference results.
M. The original hypotheses are reported, even if the results are not what the researcher desired to obtain.
N. The actual data are reported as such, in spite of the possibility that the hypotheses are not supported with the results.

Bibliography

Allen, E.M. Why are research grant applications disapproved? Science, 1960, 132, 1532-1534.

Barber, T.X. Pitfalls in human research N.Y.: Pergamon Press, 1976.

Best, J.W. Research in education. Englewood Cliffs: Prentice Hall, 1970.

Brewer, J.K. Everything you always wanted to know about statistics, but didn't know how to ask. Sarasota: Omni Press, 1975.

Campbell, D.T. & Stanley, J.C. Experimental and quasi-experimental designs for research. Chicago: Rand Mc Nally, 1963.

Chase, J.M. Normative criteria for scientific publication. The American Sociologist, 1970, 5, 262-265.

Ethical principles in the conduct of research with human participants . WDC: American Psychological Association, Inc, 1973.

Galfo, A.J. & Miller, E. Interpreting educational research. Dubuque, Iowa: William Brown, Co., 1965.

Glass, G. V. Primary, secondary, and meta-analysis of research. Educational Researcher . Nov. 1976, 5 (10), 3-8.

Hicks, C.R. Fundamental concepts in the design of experiments . N.Y.: Holt, Rinehart & Winston, 1973.

Huck, S.W., Cormier, W.H., and Bounds, W.G. Reading statistics and research. N.Y.: Harper & Row, 1974.

Johnson, G.B. A method for evaluating research articles in education. Journal of Educational Research, 1957, 51, 149-151.

Kerlinger, F.N. Foundations of behavioral research (2nd edition), N.Y.: Holt, Rinehart, & Winston, 1973.

Krathwohl, D. Improving educational research and development. Educational Researcher. April, 1977, 6 (4), 8-14.

Michael, J.A. & Weinberger. Federal restrictions on educational research: Protection for research participants. Educational Researcher . Jan , 1977, 6 (1), 3-8.

Sax, G. Empirical foundations of educational research. Englewood Cliffs: Prentice Hall, 1968.

Scott, W.A. Interreferee agreement on some characteritsics of manuscripts submitted to the Journal of Personality and Social Psychology. American Psychologist, 1974, 29, 698-702.

Stephens, J.M. Making dependable use of published research: A proposed checklist. Journal of Educational Research, 1967, 61, 99-104.

Symonds, P.M. A research checklist in educational psychology. Journal of Educational Psychology, 1956, 47, 100-109.

Van Dalen, D.B. Understanding educational research, (3rd edition), N.Y.: McGraw Hill, 1973.

Willner, W. & Hendricks, P.B. Grants administration. WDC: National Graduate University, 1972.

Wolff, W.M. Publication problems in psychology and an explicit evaluation schema for manuscripts. American Psychologist, 1973, 28, 257-261.

Appendix B

Adjunct Questions: A Timely Focus on Intellectual Skills

Amy S. Ackerman

DRAFT

Adjunct Questions: A Timely Focus on Intellectual Skills

The purpose and design of this paper are two-fold. The first part of the paper examines selected studies which deal with the use of adjunct questions (test-like items added to learning materials to assist the learner in practicing appropriate responses to the objectives of the instructor), as facilitators to the learning of verbal information (recall of facts, Gagné, 1977), and discusses some of the inadequacies of the studies, as observed by this writer. The second part of the paper consists of a proposed experimental study which addresses the use of adjunct questions with intellectual skill materials, and which is designed to correct some of the flaws observed in the studies which were analyzed and reported in the first part of the paper.

Part I

Review of the Literature

Twenty-five articles related to the use of adjunct questions as facilitators to the learning of verbal information were reviewed intensively and are listed as references for this paper. Fifteen of the articles were selected for more detailed analyses in terms of critical variables which may influence study results. These studies are presented by author and year in Table I. Analyses of critical variables relating to each study are also included in tabular form. A synthesizing discussion of the studies centered around each of the selected variables follows the table. The first part of the paper concludes with a discussion of the reported results and some observed research deficiencies.

Table A - Composite of studies using adjunct questions

Author/year	Ed. level participants	N	Materials			Administrative directions	Correct response feedback	Study time controlled	Referral back	Results
			passage length	type of learning	content					
Bertou &, 1972	9th grade	176	30 min. VTR	Verbal info.	Atomic energy			Yes	No	Significant effect with use of adj. questions
Boker, 1974	Undergrads Ed. Psych.	108	2500 words	Verbal info.	Historical geology	Told to expect test	No	No	No	Prequestions depressed incidental lrng; postquest. enhanced int. & incid. lrng
Boyd, 1973	Undergrads	220	2000 words	Verbal info.	History-Botswana	Told to expect questions		No	No	Exp. mean was below control mean--incidental lrng.
Frase &, 1970	Undergrads Ed. Psych.	270	2000 words	Verbal info.	Ed. Psych.	Explicit details		No	No	Frequent prequest- exp grp mean below control grp. Infrequent quest. enhanced.
Gustafson&, 1970	High school Seniors	58	23,000 words	Verbal info.	Intro to Computers	No	Page number to locate answer	No	Yes	Nonsignificant difference. Exp. grp. 34 min faster.
Hershberger 1964	5th grade	160	3500 words	Verbal info.	Blood; Texas	Explicit details	No	No	Yes	Self-tests increased amounts of learning
Hlynka, 1977	Grad. students	104	3 articles	Verbal info.	Film music	Brief intro.	No	No		Adj. quest. increased lrng. Obj. increased attitude.
Peeck, 1970	Undergrads Psych.	72	3000 words	Verbal info.	Greece	Explicit details	No	Yes	Yes	Prequest. depressed incid. lrng.; increase intent. lrg Control grp equal amt. lrng
Pressey, 1964	Undergrads	62	11 pages	Verbal info.	Ed. psych.		Page number to locate answer	No		Adj. quest. grp. scored 79% above control median
Rothkopf, 1966	Undergrads	159	5200 words	Verbal info.	Sea around Us	Explicit details	Yes	No	No	Quest. after facilitated both intent & incid. lrng.
Rothkopf &, 1967	High school	252	9000 words	Verbal info.	Sea around Us	Explicit details	Page number to locate answer	No	No	Quest. after facilitated lrng. of specific subsets.

123

Shavelson&, 1974	Junior College	87	1525 words	Verbal info.	Earth-quake	Explicit details	Yes			Higher order quest. facil. incid. lrng.
Swenson &, 1974	5th/6th	109	1320 words	Verbal info	Island Ako	Told to read carefully		No	No	Post quest. enhanced intent. lrng.; no diff w/ incid. lrg
Washburne, 1929	8th/9th	1456	3000 words	Verbal info.	Social science			Yes	Yes	Quest. before more effective; data reanalyzed to reveal no difference

The variables selected for analysis and discussion are as follows:

1. Age of the participant
2. Materials
3. Administrative directions
4. Correct response feedback
5. Referral back
6. Study time control

Age of the participant

Examination of Table I indicates that two of the studies reported used elementary school students as participants.

Materials

All of the materials involved in the studies reviewed consisted of verbal information which required recall of facts during testing. The content areas included educational psychology, cultural studies, social sciences, and technological sciences. The passage lengths ranged from 1,320 words to 23,000 words, and the number of participants ranged from 58 to 1,456. The level of questions was seldom indicated.

Only two of the reports included in this paper referred to any type of formative evaluation conducted on the materials, prior to use in the experiments (Shavelson & Berliner, 1974; Gustafson & Toole, 1970). Thus, the reliability and validity of the results of the materials used in these studies might be questioned.

Administrative directions

Four of the studies listed in Table I included specific directions given to the participants with respect to the purposes of the study, recommended strategies that might be employed during completion of the

materials, or what type of post test to expect following the passage reading.

In only one report was there any mention of individual debriefing of participants which discussed results and pursued types of strategies utilized during the experiment (Shavelson & Berliner, 1974).

In one of the studies, it was reported that the participants were informed they would be tested only on information in passages that related to stated objectives, but they were later tested on all of the material (Rothkopf & Kaplan, 1972). Since no debriefing was reported, the appropriateness of such procedures may be questioned.

Feedback (knowledge of results)

Hershberger (1964), employed what he termed "self-evaluative" response items which were not followed with formal confirmation or reinforcement of response. However, if the learner could not respond, he was instructed to reread the section in order to locate the correct answer. The self-tests in this study did, in fact, increase the amount of learning.

Reference page numbers for correct answers were provided in some studies; correct responses to adjunct questions which enabled participants to check their answers were included in others.

Referral back

In four of the studies referral back to previous questions or materials was permitted.

Study time

Of the fifteen studies reported in Table I, only three indicated that study time was a controlled variable. However, in most of the other studies, the study time was recorded even when it was not controlled.

Reported results

The wide variation in the studies which deal with the use of adjunct questions causes difficulty in the generalization of conclusions. The experimental control of variables appears to be highly inconsistent, the administrative procedures vary (from non-existent to detailed and explicit directions), and the results are inconclusive and in some cases appear to be contradictory.

The reader is referred to the "results" column in Table I for brief, details of the specific results of the fifteen studies analyzed for the purposes of this paper.

Gaps and pitfalls in the literature

The research regarding adjunct questions appears to be deficient in many areas, as observed by this writer and others. Some of these inadequate areas are:

1. Lack of theoretical framework (Barry, 1974;Carver,1972).
2. Uncontrolled or unreported time (Carver,1972;Faw & Waller, 1976).
3. Absence of operational definitions.
4. Lack of formative evaluation conducted on experimental materials.
5. Absence of longitudinal studies (Faw & Waller, 1976).
6. Failure to inform participants of purposes of the experiment, recommended strategies, or what to expect.
7. Absence of debriefing interviews to determine what strategies were actually employed.
8. Unrealistic environments such as no referral back.
9. Inappropriate statistical procedures (Ladas, 1973).
10. Effect of procedures on different ability groups.
11. Concentration on verbal information (recall of facts) rather than intellectual skills.

12. Absence of reported measures of participant attitude concerning experimental procedures and materials.

Part II

Using Adjunct Questions with Intellectual Skill Materials

Statement of the Problem

The overwhelming majority of the studies which deal with adjunct questions require the recall of factual information, and are consequently classified as verbal information. Difficulty in forming conclusions in regard to the values of the use of adjunct questions to augment learning may be attributed, in part at least, to inconsistent experimental control of variables and to the diversified variation of administrative directions employed in the studies. The lack of consistency in the studies may be exemplified by the observation that only three of the fifteen studies appearing in Table I provided for controlled study time, only four permitted referral back, and only three supplied the participants with correct response feedback.

Thus, the question, "Does the use of adjunct questions as facilitators to the acquisition of intellectual skills (which enable an individual to interact with his/her environment using symbols as exemplified in reading and writing, Gagné, 1977), enhance learning when explicit directions are provided, study time is controlled, referral back is permitted, and correct response feedback is supplied?" appears to be unanswered by present research, and becomes the problem of this proposed experimental study.

Hypotheses

Given learning materials requiring the acquisition and utilization of intellectual skills, with time held constant and referral back permitted, sixth grade students who use

A. adjunct questions

B. a learning hierarchy that permits self-monitoring of progress

C. detailed study directions

singly, or in combination, will

1. score higher on a posttest assessing the terminal objective and subordinate competencies than those who do not use A,B, or C above,
2. develop a more positive attitude toward the learning materials than those who do not use A,B, or C above,
3. score higher on a delayed retention test assessing the terminal objective and subordinate competencies, administered one month after the experiment, than those who do not use A,B, or C above.

Rationale

The review of literature related to the use of adjunct questions as facilitators to learning reported in the first part of this paper, demonstrated that few studies controlled time, permitted referral back, provided administrative directions, and involved elementary school children. Further, only one study reported attitudinal measurement, and none included learning materials which involved intellectual skill acquisition.

It is proposed, therefore, that an experimental study be conducted which attempts to fill the abyss as stated above, and provide data which may begin to address the many unanswered questions associated with the use of adjunct questions.

Significance of the study

Designers of instruction, text book authors, and educators may benefit from data collected as a result of this study, due to the lack of previous attention to children utilizing adjunct questions in learning materials which involve intellectual skills, which comprise an essential portion of formal education. The results may enable the above mentioned to determine where time and money may be invested most efficiently and effectively; should adjunct questions be incorporated into instructional materials, or perhaps merely the statement of explicit directions and extended study might suffice while producing comparable achievements.

With current focus on acquisition of survival skills within individuals, self-regulation and monitoring of one's learning may serve as an impetus to promote an increased desire for additional learning.

Delayed retention tests of the intellectual skills to be acquired as a result of the learning materials, will indicate what type of long term effects might be anticipated in conjunction with the use of variables as proposed in this experimental study.

The results of this study will provide insight as to the determination of the locus of control for learning; should this control be delegated to the teacher, the learning material, or to the student? The study will demonstrate outcome effects (achievement and attitude), when the partnership between student and learning material is manipulated, and hence, provide data which may be considered when making future educational decisions.

Methodology

Participants. Approximately 240 sixth grade students from the seven elementary schools in Valdosta,Georgia, comprise the sample of the target population (sixth graders in the State of Georgia), in this proposed experiment. Permission for the students to participate in the study will be obtained from the administrators, teachers, and parents/guardians of all the sixth graders in the Valdosta School System.

Using a random number table, eight heterogeneously grouped sixth grade classes, which average 30 pupils per class, will be selected from the seven schools for participation in the study. Again, using a random table, the students within these eight classes will be assigned to one of the eight groups. It is possible, therefore, that the students in a single classroom may be assigned to the eight different groups.

Each of the randomly assigned groups will use a different self-instructional module which involves intellectual skill development related to the interpretation of road maps using the metric system.

Design. The experimental variables for this study are to be arranged in a 2 X 2 X 2 factorial design (see Figure 1).

Figure 1. 2 X 2 X 2 factorial design for adjunct question investigation using intellectual skill materials.

	Adjunct questions		No adjunct questions	
	Hierarchy	No hierarchy	Hierarchy	No hierarchy
Detailed directions	① 30	② 30	⑤ 30	⑥ 30
No detailed directions	③ 30	④ 30	⑦ 30	⑧ 30

N= 240

The independent variables are as follows:

1. use of adjunct questions
2. presence of learning hierarchy
3. provision of detailed directions to the participants.

The dependent variables are attitude and achievement. Those groups whose self-instructional modules do not contain the independent variables will serve as the control groups. The levels (as indicated in Figure 1), reveal the absence or presence of the forenamed variables.

Materials. Eight self-instructional modules, in printed format, will be used in this experiment:

1. A module with adjunct questions, a learning hierarchy, and detailed directions.
2. A module with adjunct questions and detailed directions.
3. A module with adjunct questions and a learning hierarchy.
4. A module with adjunct questions.
5. A module with a learning hierarchy and detailed directions.
6. A module with detailed directions.
7. A module with a learning hierarchy.
8. A module without any of the above independent variables.

After intensive formative evaluation and revision of the modules, conducted by this writer, a pilot study will be implemented to validate the materials and the learning hierarchy, and the entry levels for these sixth graders will be determined. Further, all tests and attitude instruments will undergo formative evaluation procedures in order to verify that desirable levels of reliability and validity will result in the scores

produced through the administration of these instruments. This pilot study will also enable the experimenter to determine the amount of time necessary for completion of the modules, which is targeted to be approximately four hours, excluding administration of pre and post tests. The materials are to be designed in such a manner that for the most part, no teacher intervention is required.

Each module will contain a statement of the terminal task to be performed upon completion of the materials. The modules which include adjunct questions will ask the students, after stimulus material is presented, to respond to test-like items which assess mastery of each subordinate competency. Feedback will be provided concerning knowledge of results on any item which requires a response. The items will appear in multiple choice, short answer, and matching formats. Alternate forms of the pretest will be used for the posttest and retention test in order to prevent pretesting from becoming a threat to internal validity. The pre, post, and retention tests will evaluate the participants' ability to demonstrate the terminal task, as well as the subordinate competencies.

A seven-point Likert scale will be designed for use as the attitude instrument. Seven points were chosen in order to increase variance and result in higher reliability in the scores.

The modules containing hierarchies and directions will enable the student to monitor his progress through the materials by "traveling the hierarchy" as each subordinate competency is attained.

Detailed directions are provided in some of the modules, which suggest study procedures which will enhance the use of cognitive strategies when completing the materials.

Those modules without adjunct questions will contain instructions for

the students to study the materials in the event there is time remaining. No distracting activities will be given to exhaust the additional time.

Procedure. The classroom teachers of the eight sixth grade classes selected for the study will be provided the opportunity to participate in a thorough training session related to the purposes and procedures of the experiment. It is essential that they be informed as to the details of the experiment since they will be responsible for the conduct of the experiment in the classrooms.

It is anticipated that the study can be conducted in a period of two weeks by devoting one half hour per day to the modules in each class.

The first activity of the experiment is the administration of the pretest to all students within the sample, in order to determine whether any of them are capable of completing the terminal task without the benefit of instruction. Other first day activities include a brief explanation of the experiment to the students and distribution of the self-instructional modules.

The students will spend one half hour each of the next eight days, (days 2-9), working independently on their modules under the supervision of their classroom teachers who will control time and answer and record any questions that might arise. Referral back will be permitted.

The last day of the experiment will be devoted to administration of the posttest and attitudinal instrument.

One month later, a delayed retention test will be given to the participants. After data collection and analysis, the participants will be informed as to the results of the study, and once again thanked for their assistance. With the exception of the pretest, the participants will receive feedback concerning the correct responses to each item on any test administered.

Threats to Validity

Internal validity. This study has been designed in order to avoid threats to internal validity. However, the possibility of pretest procedures influencing performance cannot be totally ignored. Thus, alternate forms of tests will be generated for the posttest and retention test. Other sources that may cause threats to the internal validity appear to have been diminished as a result of the precautions that have been taken in the design of the experiment.

External validity. Because the pretest procedures are not highly unusual, nor do they involve deception, surprise, or stress, the pretesting will not jeopardize the external validity in this study. The reactive effect of the experimental procedures might have been a concern; however, the control groups will also be completing modules. Thus, the avoidance of a "no treatment" group has been included in this experiment. Further, neither the participants nor the teachers will be informed beforehand as to which type of materials (modules), are being completed by the individual students. The regular teachers will conduct the experiment, and for the most part, no intervention will be necessary with the self-instructional modules.

The major concern regarding external validity is the limitation imposed by the use of participants who live in one Georgian town. Although these students may represent sixth graders throughout the state, due to their heterogeneous grouping, this has not yet been verified. Thus, generalizing the results of this study to other sixth graders must be done in moderation until additional data can be collected throughout the State of Georgia.

Statistical Analysis

Three way multivariate analysis of variance will enable the researcher to test for significant interactions and or main effects between the means of the groups on the dependent variables (achievement and attitude). Significant interactions and or main effects, will be followed-up with multiple comparisons by Scheffé's contrast method.

A one way analysis of covariance, with the posttest as the covariate, will be used to analyze the results of the delayed retention test.

Bibliography

Barry, R.J. The concept of mathemagenic behaviour: An analysis of its heuristic value. Perceptual and Motor Skills, 1974, 38, 311-321.

Bertou, P.D., Clasen, R.E., & Lambert, P. An analysis of the relative efficacy of advanced organizers, post organizers, interspersed questions, and combinations thereof in facilitating learning and retention from a televised lecture. Journal of Educational Research, March 1972, 65, (7), 329-333.

Boker, J.R. Immediate and delayed retention effects of interspersing questions in written instructional passages. Journal of Educational Pyschology, 1974, 66, (1) 96-98.

Boyd, W.M. Repeating questions in prose learning. Journal of Educational Pyschology, 1973, 64, (1) 31-38.

Bruning, R.H. Effects of review and test-like events within the learning of prose material. Journal of Educational Psychology, 1968, 59, 16-19.

Carroll, J.B. A model for school learning. Teachers College Record, 1963, 64, 723-733.

Carroll, J.B. Learning from verbal discourse in educational media: A review of the literature. (Research Bulletin RB-71-61) Princeton, N.J.; Educational Testing Service, October 1971.

Carver, R.P. A critical review of mathemagenic behaviours and the effect of questions on the retention of prose materials. Journal of Reading Behavior, Spring 1972, 4, (2), 93-118.

Faw, H.W. & Waller, T.G. Mathemagenic behaviours and efficiency in learning from prose materials: Review, critique, and recommendations. Review of Educational Research, Fall 1976, 46, (4), 691-719.

Frase, L.T., Patrick, E., & Schumer, H. Effect of question position and frequency upon learning from text under different levels of incentive. Journal of Educational Psychology, 1970, 61, (1), 52-56.

Gagne', R.M. The conditions of learning (3rd ed.). New York: Holt, Rinehart, and Winston, 1977.

Gustafson, H.W. & Toole, D.L. Effects of adjunct questions, pretesting, and degree of student supervision on learning from an instructional text. Journal of Experimental Education, Fall 1970, 39, (1), 53-58.

Hershberger, W. Self-evaluational responding and typographical cueing: Techniques for programing self-instructional reading materials. Journal of Educational Psychology, 1964, 55, (5), 288-296.

Hlynka, D. What goes into a learning package? Unpublished paper presented to AECT (Association of Educational Communication and Technology) Convention, Miami Beach, 1977.

Peeck, J. Effect of prequestions on delayed retention of prose material. Journal of Educational Psychology, 1970, 61, (3), 241-246.

Pressey, S.L. A puncture of the huge "programing" boom? Teachers College Record, January 1964, 65, (4), 413-418.

Ladas, H. The mathemagenic effects of factual review questions on the learning of incidental information: A critical review. Review of Educational Research, Winter 1973, 43, (1), 71-83.

Rothkopf, E.Z. Learning from written instructive materials: An exploration of the control of inspection behavior by test-like events. American Educational Research Journal, 1966, 3, (4), 241-8.

Rothkopf, E.Z. The concept of mathemagenic activities. Review of Educational Research, 1970, 40, (3), 325-336.

Rothkopf, E.Z. Experiments on mathemagenic behavior and the technology of written instruction. In E. Rothkopf & P. Johnson (Eds.), Verbal learning research and the technology of written instruction. New York: Teachers College, Columbia University, 1971, 284-303.

Rothkopf, E.Z. Barbarism and mathemagenic activities: Comments on criticism by Carver. Journal of Reading Behavior, April 1974, 6, (1) 3-8.

Rothkopf, E.Z. & Bisbicos, E.E. Selective facilitative effects of interspersed questions on learning from written materials. Journal of Educational Psychology, 1967, 58, (1) 56-61.

Rothkopf, E.Z. & Kaplan, R. Exploration of the effect of density and specificity of instructional objectives on learning from text. Journal of Educational Psychology, 1972, 63, 295-302.

Shavelson, R.J. & Berliner, D. Effects of position and type of question on learning from prose material: Interaction of treatments with individual differences. Journal of Educational Psychology, 1974, 66, (1), 40-48.

Swenson, I. & Kulhavy, R.W. Adjunct questions and the comprehension of prose by children. Journal of Educational Psychology, 1974, 66, (2), 212-215.

Washburne, J.N. The use of questions in social science material. Journal of Educational Psychology, 1929, 20, 321-359.